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ADMIRAL SIR FREDERICK W. E. NICOLSON, BART., C.B., Vice-President, in the Chair.

THE ATTACK OF ARMOUR-CLAD VESSELS BY ARTILLERY.

(The original Lecture was delivered at the Royal Artillery Institution on October 19th, 1881.[1])

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PROBABLY most Officers will agree to the statement that it is very desirable in the case of a deliberate engagement to know the nature of armour carried by an enemy, and also its thickness, within reasonable limits. It may be well to observe that it ought, in most cases, to be possible to obtain this information, for the number of armour-clad vessels possessed by any Power is limited, and such vessels are built sufficiently slowly for their most important features to become widely known before they are afloat, both with regard to outward appearance and construction. It is necessary to state this fact, for on it depends substantially any value that this paper may possess.

When possible, it seems important that a decision should be made as to whether the armoured portion of the ship, containing what may be termed the vital parts, should be attacked, or whether it would be better to bring the battery to bear on to the less protected or unprotected parts. For the sake of distinction, I term the former the "*primary*," and the latter the "*secondary*" attack. Besides, there is also the attack of the horizontal armour on the deck, which is almost a separate question of its own, which, for the sake of convenience, is here put between the primary and the secondary attack. The primary and secondary attacks are best carried out with entirely different kinds of ammunition. It is for this reason that it appears important

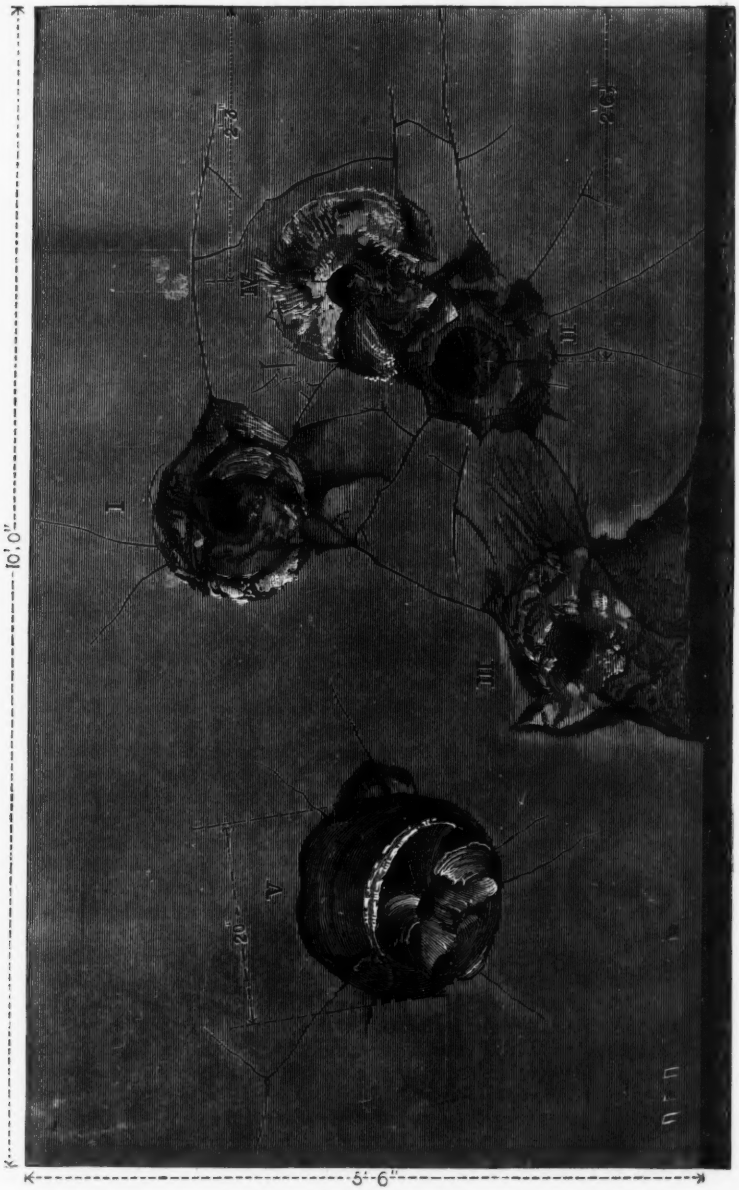
[1] The Institution is indebted to the Committee of the Royal Artillery Institution for the use of the blocks which illustrate the lecture.

to adopt and follow one or the other plan of attack thoroughly, instead of firing armour-piercing shells indiscriminately at every armour-clad ship.

Primary Attack.

Whether a ship's armoured portion can be attacked by any given gun with advantage or not, depends on the *nature* and *thickness* of her armour. *Steel* distributes the shock of impact through its mass, and hence it has great power in resisting a single blow, but it is liable to succumb to the continued fire even of inferior guns. No better illustration of this could be given than the comparative behaviour of the 22-inch steel and iron plates at Spezia in 1876. The steel crumbled away gradually, even under the fire of 10-inch guns, a fire which proved almost harmless to the 22-inch wrought-iron plates. On the other hand, the steel completely stopped the projectile of the 100-ton gun, which enormously outmatched it. This it did at the expense of the plate, itself shivering into fragments, while the iron allowed this projectile to pass completely through it; both experiments were repeated with the same results. It may be seen, then, that *penetration* through steel is hardly to be looked for, but rather the shattering of it.

A steel-clad ship, from its power to resist a single blow, is admirably suited for running past a small number of guns, however heavy they may be; but, on the other hand, it suffers from the continued fire even of light guns: hence it might depend on the probable duration of an attack whether it was wise to fire at a ship's side armour or only at her unarmoured places. The effect of a shot against steel plates is probably proportional, not to the shot's power of penetration, but to the stored-up work contained in the shot at the moment of impact, which is expressed by $\frac{Wv^2}{2g}$, where W is the shot's weight, v the striking velocity, and g the force of gravity. To take an example:—The 9·45-inch Krupp B.L. gun, firing a shot weighing 348·3 lbs., with a velocity of 1,890 feet a second, can, according to Colonel Inglis, penetrate a plate 18·1 inches thick. The 38-ton gun, 12·5 inches calibre, firing a shot weighing 812 lbs., can penetrate a plate 17·9 inches thick only. That is to say, of the two, the Krupp gun has rather the advantage in penetrating wrought-iron. On the other hand, it may be seen that the 38-ton gun shot has about 12,260 foot-tons stored-up work, whereas the Krupp gun has only 8,630 foot-tons work. Consequently, while the latter gun would be equal, or slightly superior to the former if fired against iron, two rounds of the former would probably produce nearly the same effect as three rounds of the latter against steel plates. It appears reasonable to suppose that the cracking of the steel represents the stored-up work in the shot as fully as the shearing effected in the wrought-iron; although, in so curious a mechanical problem as the cracking and breaking up of steel which goes on for some minutes after the moment of impact, it is unsafe to dogmatize. One conclusion arrived at by the Sub-Committee on Plates and Projectiles is, that it is necessary to attack steel-faced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armour with steel projectiles; the fact, I believe, being that chilled iron under the sudden resistance experienced breaks up before the conditions favourable to its success are established.

Steel-faced armour, that is, armour composed of a wrought-iron foundation plate and steel-face plate, comes under the heading of steel in a modified form: not that a plate composed of a compromise between steel and wrought-iron would answer, for the object is to have a hard surface and tough back. Compound armour, however, so far behaves like steel, that it is seldom fairly penetrated, but generally destroyed by fracture. It has recently exhibited great powers of resistance. The diagram on page 3 shows the condition of a compound 11-inch plate of Brown's after being struck by the following projectiles:—Three 9-inch chilled shot from a 12-ton gun, one 9-inch steel with chilled point, and one 12·5-inch steel shot from a 38-ton gun. The latter projectile has only penetrated to a depth of from two to three inches in the steel, flattening out and breaking up, but still making a hole through the plate at the point of impact. The metal in the shot may be rather soft, but the shield has borne its blow of 11,820 foot-tons admirably. Three of the 9-inch shot contain about the same total quantity of work. I fear, however, that it would be difficult to make a diagram such as would enable you to compare the effect of the one heavy and three light projectiles.

Wrought-Iron.

Wrought-iron yields locally at the point of impact only. It is universally admitted that for direct fire a sharp-pointed projectile is best. This forces in its sharp point, which experiences comparatively slight resistance at first, and soon gets deep enough to cause the plate to begin to yield at the back, just opposite to the shot's point, in a star or cross-shaped tear, which is opened, the corners bending back as the shot gets deeper, until at length the projectile forces its way through, mainly by tearing the iron in lines, whose lengths are directly proportional to the calibre of the gun. It is this action that appears to support the use of the first power of D, rather than the square in the formula used for so many years in the Department of the Director of Artillery. However, what is mainly to the point here is the fact that the shot shears or punches a comparatively clean hole, leaving the surrounding portions of the armour and fastenings almost uninjured. I have here two photographs, taken almost at hap-hazard, being duplicates from the R.M. Academy which were not required for cadets. These sufficiently exhibit the well-known behaviour of wrought-iron under continued fire—one in the case of direct and the other oblique fire. In the latter the effect of the blow is more distributed than in the former. For all practical purposes, however, it may be considered that unless a projectile passes through *wrought-iron* sufficiently far to cause injury by langrage, it effects nothing. Even a projectile passing bodily through, in the form of dead metal, may produce but a very limited amount of damage; the armour of the ship being left in good condition, except that it has a clean hole through it, and even that may be plugged up by the base of the projectile. In the case of

Palliser or steel shells, fired under ordinary conditions, a certain thickness of iron will probably cause the charge of the projectile of almost any gun, even the heaviest, to explode at an early stage of penetration, so that the flash does not get through the armour. So long as armour-clad ships were able to keep all *fire* out, they enjoyed a measure of security altogether beyond that belonging to wooden ships, even supposing them to be penetrated through and through.

The possible introduction of steel projectiles, which stand up to their work and retain their shape sufficiently well to allow them to carry a bursting charge entirely through the armour, seriously threatens this advantage. You see before you a 9-inch Whitworth steel shell which was fired by the Sub-Committee on Plates and Projectiles. This shell has, as far as I can ascertain, passed twice through a solid iron plate 12 inches thick. It is not of the best proportion of calibre to weight, nor has it the best shaped head, yet it is capable of carrying a gun-cotton charge unexploded through 12 inches of iron, for this was actually effected by one supplied with it. It will be seen that this danger can hardly be said to threaten *steel* armour seriously, for a shot must enormously overmatch a steel plate to get through it, as we have seen in the case of the Spezia trials.

The *increased power* that has been obtained in *new type guns* still further favours the attack of iron by penetration. Let us take an actual experiment showing what might be effected by *new type guns* firing *steel shell* with *gun-cotton* charges. At Meppen, in August, 1879, a Krupp gun, 9·45-inch calibre, weighing 17·7 tons, was fired at a target consisting of 20 inches of wrought-iron in two thicknesses, namely, 12 inches and 8 inches, sandwiched with about 3 inches of wood between the plates. The projectiles passed through the target and went 3,590 yards up the range before grazing. When recovered, they scarcely showed signs of having been fired. They could undoubtedly have carried gun-cotton charges through the plates. It is a serious reflection that a new type 18-ton gun may be able to drive a projectile carrying fire into the strongest part of any English ship afloat, except the citadel of the "Inflexible."

Where wrought-iron is concerned, then, it is practically a question either of "*perforation*" or else failing to damage at all: consequently, it is specially important to know what is the limit of a gun's power at any range. Very complete diagrams showing this have been drawn up by Colonel Inglis and Colonel Maitland, which will be found in the "Report on Plates and Projectiles." Colonel Maitland has, I believe, recently completed a diagram, from which additional information, such as the diminution of the velocity of any shot on any increase of range, can be taken directly. As Officers are not likely to want to decide these questions with guns in action, which they are handling for the first time, these diagrams might be used to furnish them complete information as to their guns before coming into action. I think, however, it may be well to have also a rough rule for fixing the limit of a gun's power against wrought-iron, which can be carried in the head: I may, therefore, point out a very simple one, namely, *one calibre thickness of armour for every thousand feet velocity.* I believe

this was noticed by different Officers in the case of the Armstrong gun trials. It is no matter of chance, but admits of mathematical proof, if two suppositions are made, neither of which is monstrous. Sometimes both are true, and how far they are wrong may always be known and allowance made. I would point out, however, that the simple application of the rule is never very far from the truth. Herewith is a table showing the thickness of plate penetrated by projectiles of nearly all the best known heavy guns at velocities of 1,000 feet, 1,500 feet, and also at the muzzle velocity of each gun as taken from Colonel Inglis' diagram, and also as obtained by this simple rule. It may be seen that in the maximum penetration column, in two cases the result is absolutely correct, in twelve instances the error of the rule is only the fraction of an inch, and in seven cases it exceeds an inch. In the two other columns the differences are rather larger. I give the mathematical proof of the rule herewith,[1] by which it may be seen that the two assumptions required are (1) that the formula formerly used in the Director of Artillery's Department is correct when the resistance of the plate is supposed to increase with the square of its thickness; (2) that the ratio of the weight to the cube diameter of the projectile is about ·4. The first of these is most nearly correct when the plate approaches two calibres in thickness, and the latter in the projectiles of new type guns is close to the truth. Whether these conditions are approximately true or not would probably be known; for an Officer would know generally whether his gun fired light or heavy projectiles in proportion to its calibre, and whether its velocity was high or low: he ought, therefore, without trouble, to get better results than those on the table. To take an example, however—where nothing is known and allowed for—say that an Officer has 9-inch guns, and supposes an enemy to be 1,000 yards off (failing actual knowledge); an old type gun's initial velocity might be guessed at 1,500 feet, and a really new type one at 2,000 feet, the velocity falling about 100 feet for every 500 yards' range. Guessing the 9-inch gun as having 1,500 feet initial velocity, and

[1] The equation formerly employed in the Director of Artillery's Department may be written—

$$t = \sqrt{\frac{W v^2}{2g \times 2\pi R \times c}}$$

where t = thickness of plate perforated, v = striking velocity, g the force of gravity, 2R or D = the diameter of hole or of shot making it, and c = a certain constant. Assuming that the weight of every projectile bears a *constant* relation to the calibre that is ($W = c'D^3$), and collecting all the constants together under the letter K, by which we may express all the constant part of the expression, we have—

$$t = \sqrt{K \frac{D^3 v^2}{D}}$$

$$= \sqrt{K D^2 v^2}$$

$$= \sqrt{K} DV.$$

Experience shows that the constant part, $\sqrt{K} = \frac{1}{1000}$; in other words, that the penetration in inches is equal to the calibre × the number of thousand feet velocity.

consequeutly 1,300 feet at 1,000 yards, the limit to possible penetration would be 1·3 calibres, or something under 12 inches. This is one of the worst examples; the 9-inch shot being light for its calibre, and the diagram shows well under 11 inches. Even this, however, is a better result than a guess is likely to yield.

Take a new type gun, however—such as the 43-ton gun—say at 1,500 yards, guessing 2,000 feet as initial velocity, and taking 300 off for the three 500 yards in the range, we get a velocity of 1,700 feet, and limit of penetration of 1·7 calibres, or something under 20½ inches. Colonel Inglis gives 20·9 inches; surely for a quick estimate, made without data, this is close. However, this subject may be dismissed by observing that Officers should be provided with diagrams, and from these obtain an accurate estimate of the powers of their guns at any likely range. Failing diagrams, a table of velocities, with the rule of one calibre for each 1,000 feet, gives a fair idea; and even if the velocity has to be guessed, the rule gives a much better estimate than a direct guess at the thickness would be likely to yield.

Supposing that the enemy is known to carry iron armour at all over the limit which is calculated for the most favourable circumstances, it is useless to fire at it, and the secondary attack might then be adopted. Before dealing with that, however, may be noticed the attack of the deck.

Attack of Decks.

This, when practicable, is probably the most formidable of all, but may be attempted with guns incapable of piercing the side armour. Batteries in positions of high command may generally prefer to fire at the deck. This attack is formidable in proportion to the descending angle, both with regard to the possibility of penetration and the mischief that may be done when penetration is achieved.

The four 100-ton guns which are going out to Malta and Gibraltar will be mounted with about 90 feet command above the sea. Unquestionably these guns would terribly injure any ship they struck on the deck. Probably they would employ common shells. The more common case to consider would be that of much smaller pieces. It was concluded at Shoeburyness, in 1870, that 9-inch guns at 8° would not penetrate single inch decks at 100 yards. At 15° it appears from recent experiments, they would destroy double that thickness of deck plating. The position of the ship affects this question: a broadside view gives but little opportunity. On the other hand, some vessels have special protection when lying head on. The armour bulkhead of the "Shannon" is an instance; she might be much better struck from astern. In some cases, I believe, vessels attack by following each other on an elliptical path, firing in succession from the nearest point to the fort. In such a case some guns might be devoted to fire at the receding vessels. On the occasion of her capture the "Huascar" kept her stern away from the enemy systematically.

The attack of decks by high angle or mortar fire has generally been little considered owing to the inaccuracy of ordinary mortar fire. At Meppen, in August, 1879, Krupp fired an 11-inch howitzer at

28° 36′ elevation at a horizontal target meant to represent the deck of the "Inflexible," though rather larger, being 100 metres (328 feet) long, and 25 metres (82 feet) broad. The range was 6,700 metres (7,327 yards) to the bows, which were presented towards the firing point. Out of ten rounds five fell on the deck, the four last all being within about 3 feet of the centre of the deck. The shell weighed 476·3 lbs., and the firing charge was 39·7 lbs.

This firing appears to me to be far too accurate to justify the question of vertical fire being neglected, at all events at an enemy at anchor.

Secondary Attack.

Protected vessels have latterly come in in notable instances where the armour is almost confined to the water-line, as in the "Shannon" class; or to the machinery, &c. (vital parts), as in the "Italia" and "Lepanto." Even citadel ships, like the "Inflexible," "Duilio," "Dandolo," "Ajax," "Agamemnon," "Majestic," and "Colossus," have unarmoured ends, which may be attacked by ordinary projectiles. In fact, armour-piercing projectiles would be likely to do little injury to these parts, for projectiles which depend on violent impact for firing their powder most likely would not explode at all. The Director of Naval Ordnance, in writing on the "Inflexible" about 1877, said:—"The projectiles that would be fired at the 'Inflexible' "would certainly be armour-piercing, either chilled iron or steel; and "such shell would not burst in passing through the thin iron sides of "the ship, as they require the resistance of armour to ignite the "bursting charge." The Committee wrote:—"The most effective "armament to bring against the 'Inflexible's' ends alone would "undoubtedly be one of numerous shell guns." At the present time, perhaps, we should hardly assume that every foreign Naval or other Artillery Officer would prefer an inefficient mode of attack to an efficient one. Possibly, however, few Officers present even to-day would think of attacking an armour-clad in her weak parts with *shrapnel shells* and *sensitive fuzes*. Yet the "Shannon" trials at Shoeburyness, in 1875–76, indicated that this was often the most effectual kind of fire. The profile resembling the "Shannon" at Shoeburyness had 1 inch of iron and steel in different portions. Common shells with Pettmann fuzes sometimes acted well, but more frequently broke into a few fragments, the powder only firing after the fracture, and so burning without much effect. Even with the Laboratory sensitive or direct action fuzes this was liable to happen. The behaviour of shrapnel, which break up into a multitude of fragments and bullets, is much less dependent on the bursting charge than that of common shell. One shrapnel in these trials dismounted a gun and destroyed the entire detachment, and the effect of these shells was generally remarkably good. Probably common shell for incendiary effect, and shrapnel to sweep the batteries, both having sensitive fuzes, would be the proper projectiles to fire. It is important to bear in mind that common shell have been found equal to the penetration

of armour half their calibre thick, that is, 10-inch shells 5 inches, a 16-inch shell 8 inches.

The portions of ships below the water-line may appear to some to present a vulnerable spot to aim at; and doubtless this is a possibility to be kept in view, but it is at present scarcely feasible to strike the sides of English, or most foreign, ships below the water-line. The *conning tower* is another important mark for attack. It may be remembered that Admiral Grau was killed in the conning tower of the "Huascar," which was repeatedly struck and destroyed by the guns of her adversaries. The *funnel* may appear to be a tempting mark for light guns, but little can be done by striking it above deck, as the following consideration may show:—

The boilers are placed low down in the hull, and the funnels must be measured from the fire grates. Suppose the total length of funnel to be 50 feet, and that it is cut down to 30 feet. The diminished power of generating steam will be to the original power in the proportion of $\sqrt{30}$ to $\sqrt{50}$, that is 5·5 to 7·1. The ratio of the speed is, I believe, proportional to the cube root of the generating power, that is, as $\sqrt[3]{5{\cdot}5}$ to $\sqrt[3]{7{\cdot}1}$, or about 1·763 to 1·920. In other words, the vessel would only lose 1 knot in 12 by such an injury—though inconvenience might doubtless be felt from the escape of smoke on deck.

Models of Ships of War.

These models of hulls are intended to show the general plan and the disposition of guns and armour of a few typical ships of war, to enable Officers to understand their general construction, and form their own judgment as to how coast batteries should deal with the classes of vessels they represent. The projectiles and fuzes recommended are those indicated by experiments, in some cases not yet introduced into the Service.

The models are all made to the same scale, viz., 16 feet to the inch. They are painted in accordance with the vessels they represent, except that, on one-half, sections of the armour and the face of it also are painted. Wrought-iron is coloured dark blue, and steel plum-coloured, or light bluish colour (*vide* face of "Inflexible" turret). They are weighted with lead to float nearly at the depth of the water-line.

The "Glatton" and "Inflexible" are made from Admiralty drawings, and have been corrected in the Admiralty, and are fairly accurate. The "Admiral Duperré" and "Polyphemus" are made chiefly from drawings in "King's War Ships," and "The Engineer," and do not claim to be accurate in all respects.

"*Glatton*" (*British*).

Coast defence; breastwork, single turret type; length between perpendiculars 245 feet, extreme breadth 54 feet, displacement 4,912 tons.

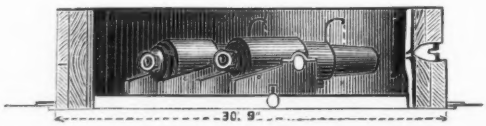
The principal artillery features are:—

All-round fire with two 25-ton guns, combined with *complete protection* by *heavy* armour. She is fitted to engage with an enemy of great

power, because her all-round fire enables her to place herself obliquely to the enemy's guns. When built, it appeared as if she was unlikely to suffer from the effect of the heaviest guns then extant.

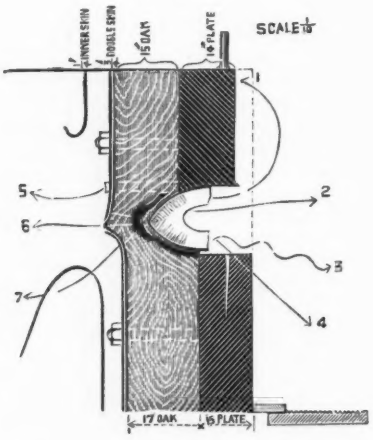
At Portland, in 1872, her turret was fired at by the 25-ton gun of the "Hotspur." One round struck the centre of the turret near the ports; the plates were forced back $5\frac{1}{2}$ inches, and some distortion caused (Figs. 2 and 3). The second round struck the junction of the

FIG. 2.



turret with the glacis-plate of the deck (Fig. 4). The object being to try the effect of wedging the turret and so preventing its working, the shots were directed at the most likely places to cause this, the 14-inch plates being selected rather than the 12-inch plates, which would have

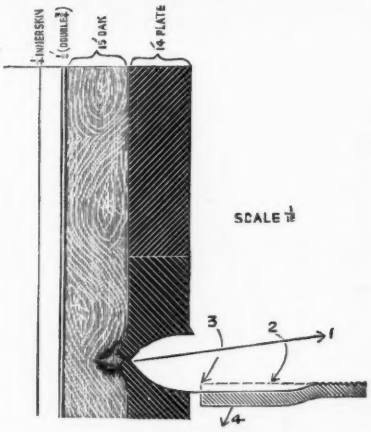
FIG. 3.



allowed the shot to pass through with less shock to the ship. Perforation was not effected, and the turret was in no way prevented from working freely.

The introduction of new type guns, firing projectiles of comparatively small calibres with high velocity, *in no way favours the operation of distorting a turret*, but rather the reverse, for the power to contort depends on the resistance offered, and this decreases with the calibre of the projectile.

FIG. 4.



The introduction of new type guns, and also of steel shells which remain intact after penetration, will, however, seriously detract from the invulnerability of this vessel to *penetration*. A new type 9-inch gun might undoubtedly perforate her sides and turret at close quarters *striking directly*. Steel shells charged with gun-cotton and delay-action fuzes would be the most formidable projectiles to attack her with. Taking her altogether, with her powers of all-round fire and *complete armour*, she would still probably bear heavy artillery fire very well. Against two antagonists, the fact of her possessing only a *single turret* is a disadvantage. The Captain and staff are very secure in the conning tower immediately aft of the turret. This ship is erroneously described as having no ram in some foreign works on ships of war.

The coast defence vessels of Great Britain are the—

"Glatton."	"Gorgon."	"Wyvern."	"Magdala."
"Hotspur."	"Hecate."	"Scorpion."	"Abyssinia."
"Rupert."	"Cyclops."	"Viper."	"Cerberus."
"Prince Albert."	"Hydra."	"Vixen."	

Our sea-going turret-ships "Dreadnought," "Thunderer," &c., resemble the "Glatton" generally as to armour.

The French first class coast defenders of the "Tonnerre" class closely correspond to these.

The Russian Navy has many vessels of this type, including the "Great Peter."

"*Inflexible*" (*British*).

The largest ironclad at present afloat. Length between perpendiculars 320 feet, extreme breadth 75 feet, displacement 11,406 tons. (The Italian ships "Italia" and "Lepanto" will be larger, viz., 13,480 tons.)

Type, *Citadel*. *Diagonal turret* type of sea-going ship (*vide* elevation and plans, Fig. 5). The "Agamemnon," "Ajax," "Colossus," and

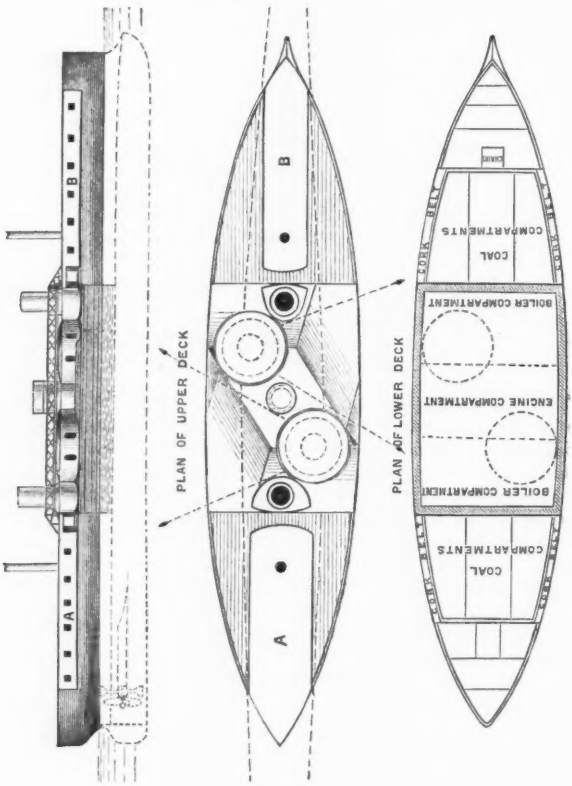
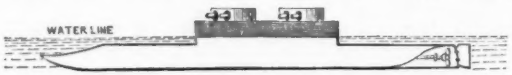


FIG. 5.

"Majestic" (English ships) are being built on the same plan. The Italian ships "Duilio" and "Dandolo" are also on the same principle.

The model is made to pull asunder (masts and rigging being left out) so as to enable the vulnerable unarmoured portions to be removed, leaving the armoured citadel, with its turrets and its submerged projecting ends covered with horizontal armour (*vide* Fig. below).



Portion of H.M.S. "Inflexible" protected by vertical or horizontal armour.

Supposing this part of the vessel only to be left sufficiently perfect to keep out water and cause displacement, thus giving floating power, the rest of the ship would be merely dead weight; and Sir E. Reed argued that in such a condition this ship, as well as the "Duilio" and "Dandolo" would be liable to capsize. Practically, considering the construction of the superstructure, with its cork, &c. (*vide* model section), this is out of the question. It could only be effected by many days of continued firing. The citadel is very heavily armoured (*vide* model)—24 inches in thickest parts. Turrets have 16 inches (17 inches at ports), the outer plate of 9 inches being steel-faced (light blue or plum colour on model section).

It would be useless to attack the heavily armoured parts of this ship with anything of much less power of penetration than the 80-ton gun. Practically the 80-ton gun would severely injure her only by repeated blows. She would also be able to resist plunging fire very well. With smaller guns all ships of this class might be attacked in the unarmoured parts by common shells and sensitive fuzes, and shrapnel with special sensitive[1] percussion fuzes. Lighter guns also might disturb the Captain and staff of the vessel posted in the corners of the iron plate cross in the conning tower[2] near the foremast (on model).

As to her own fire, the diagonal position of turrets is intended to enable the citadel to be shortened, and thus to effect a saving in armour and weight. It is also meant to give fire with four guns (80 tons) fore and aft. This has not yet been actually attempted. The turret guns have fired hitherto only up to about 15° of this line, and thus pointed are only directed on two adversaries 30° asunder.

The "Duilio" which so strongly resembles the "Inflexible," has steel armour, which might gradually be destroyed by comparatively light guns, but would probably stop a single projectile of any gun afloat. She has no deck structure for cabins like the "Inflexible," but her funnels and casings, being outside the citadel, interfere with all-round fire. The vessel is narrower than the "Inflexible," and the turrets are therefore necessarily constructed with their centres in a line making a smaller angle with the keel than is the case with the "Inflexible." Although, as already said, there is no prospect of causing a vessel of this class to capsize by destroying her unarmoured ends, these might be so far injured as to cause serious inconvenience, and they form a natural object of attack for any but the very heaviest guns.

The "Admiral Duperré."

Length on water-line 319 feet 10 inches, extreme breadth 66 feet 11 inches, displacement 10,322 tons (French); building; *special barbette type*, copied more or less in other French ships—the "Duguesclin," "Triomphante," "Victorieuse," "La Gallisonière," &c. (*vide* "King's War Ships"); is armoured only along the water-line and on the towers, being a "protected ship" rather than an

[1] Not the fuze formerly termed "sensitive."

[2] The cross plate is surrounded by very thin walls and roof in the actual ship.

"armour-clad." The guns (46-ton) revolve on turntables, one in each barbette tower. There are also fourteen broadside $5\frac{1}{2}$-inch guns unprotected (*vide* elevation and plans, Fig. 6).

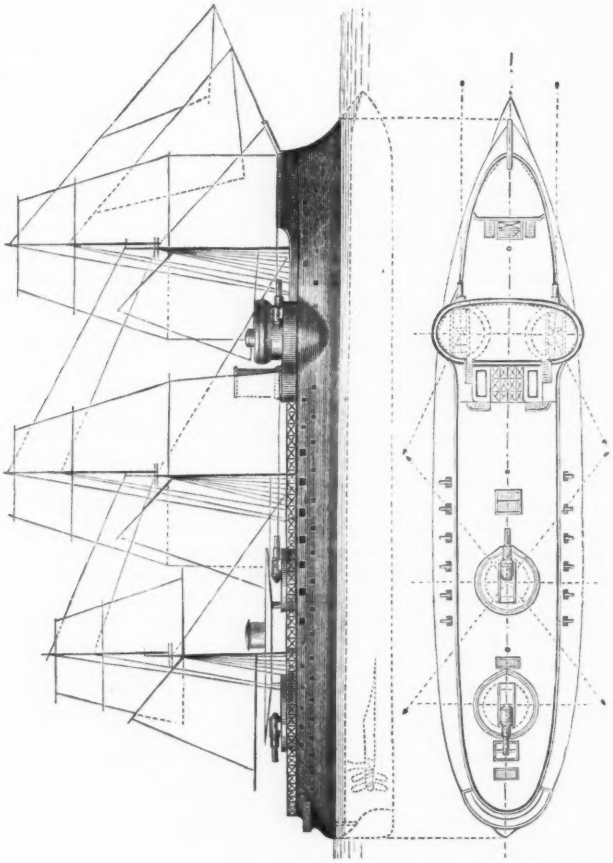


Fig. 6.

The principal artillery features are the great command of her guns ($27\frac{1}{2}$ feet above the water-line), and her power of all-round fire; though, it is to be observed, that is less complete that in turret-ships. She fires two guns directly ahead—probably only one directly astern. She can hardly fire her *four* heavy guns in any direction. She will have, however, great power of offence if she carries new type broadside guns.

Her defence is very imperfect; she is open to attack from common shells (of all calibres) with sensitive fuzes, and even larger machine-guns, in all unarmoured parts. Shrapnel with special sensitive fuzes might also be used against the broadside guns, and shrapnel with time fuzes or special percussion fuzes, and bullets from machine-guns might be directed on the men in the barbette towers, as well as common shell with percussion fuzes.

The English ship the "Collingwood" is being built on the barbette system, though with much more regard to protection than is exhibited in this ship.

The "Polyphemus."

Length on water-line 240 feet, extreme breadth 40 feet, displacement 2,640 tons. Ram and torpedo ship. She carries no heavy guns, her weapons being the torpedoes, which she discharges from her bow and on each side amidships, machine-guns, and her ram, which simply consists of her steel bow torpedo tube strengthened by ribs (*vide* model), consequently she must not be expected to discharge torpedoes from her bow after once ramming.

She is protected by steel scales and steel plating specially made by Sir J. Whitworth and Co. The sides of the vessel are made of double half-inch ship-building steel of about 26 tons per inch tenacity. The entire "turtle back" to 5 feet below the water-line is covered with a Whitworth steel inch plate (45 tons tenacity). From $2\frac{1}{2}$ feet below the water-line the turtle-back is further protected by Whitworth steel scales, till the tangent to the curved back comes down to 20° with the horizontal. These scales are each about 10 inches square and 1 inch thick, held on by one screw in the centre and one at each corner, holding down the corners of four plates, so that each plate has one screw in the centre and a quarter of a screw at each corner, making two screws for each plate throughout. The steel for the scales has a tenacity of 65 tons. The scales will resist the direct blow of any machine-gun easily, and will perhaps prove suited to resist a very *oblique* blow, even from heavy projectiles, to which only they are exposed in action.

This vessel has special peculiarities which are not artillery matters, such as the power to drop heavy weights carried along her keel (in all 240 tons) so as to make her float higher, and recover herself if a compartment fills with water, &c.

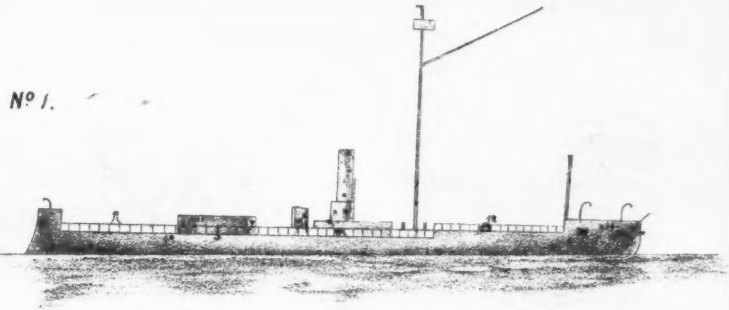
The best method of attack might be to fire armour-piercing projectiles as directly as possible, common shell, charged with gun-cotton, and percussion fuzes might also be tried. Her top structure might be destroyed by the projectiles of almost any guns. Common shells filled with gun-cotton and with percussion fuzes might probably be the best.

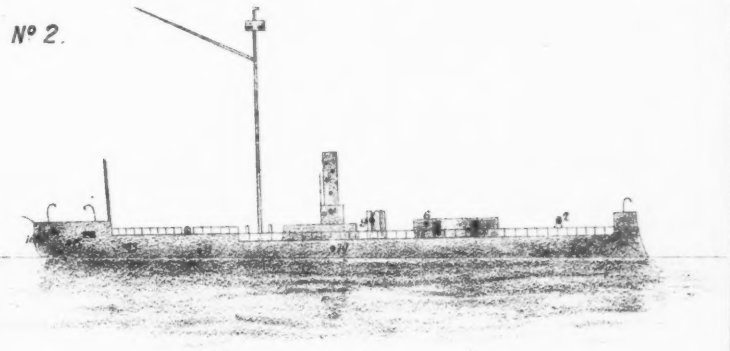
The engagements of the "Huascar"—more particularly that one which ended in her capture—may seem to deserve special notice in this paper. This is, however, a matter on which I should hope to hear something from naval Officers in discussion, and I would only put before you drawings of the "Huascar" (showing the places where

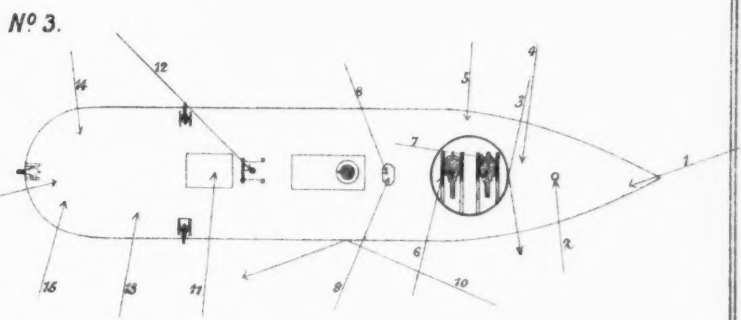
she was struck) (*vide* Plate, Figs. 1, 2, and 3) which has been kindly contributed by Lieutenant Montgomery, R.N., of H.M.S. "Shannon," adding a very few remarks.

Officers unacquainted with the "Huascar," from the general resemblance she bears to our own turret vessels, might take her to be much stronger than she really is. She has only $5\frac{1}{2}$ inches of iron on her turrets, $4\frac{1}{2}$ inches on her sides, and 3 inches on her conning tower; and she carried two 10-inch guns, two 40-pounders, and one field-gun. On the occasion of her capture she maintained a very gallant fight for $1\frac{3}{4}$ hours against two vessels, enormously outmatching her, protected by 10 inches of armour. She endeavoured to keep between them, to keep her weak parts out of fire and to ram, which was defeated by the advantage her adversary (the "Cochrane") possessed in having twin screws. Finally, when her staff and half her crew were disabled, and she had resisted one attempt to board, she surrendered. It seems ungracious to point out any flaw in so noble a defence, but the fact cannot be allowed to pass that her guns failed in their part, for neither in her encounter with the English vessels "Shah" and "Amethyst," nor on the occasion of her capture, can she ever be said to have hit any ship to any purpose, though at times at close quarters.

The two models before us, the "Inflexible" and "Admiral Duperré," may serve to remind us of certain points of contrast between our own ships and those of France. We have, either afloat or well advanced in building, eleven first class turret sea-going ships, and fifteen coast defenders, in which is embodied the principle of carrying a very few very heavy guns behind thick armour—the turret principle enabling the guns to engage on either side. The French ships have generally more pieces, but of lighter weight. The average number of heavy guns in our first class turret-ships is 6·1, and in our first class broadside ships 11·1, while in the French first class ships it is 15·3. The total weight of metal (in ordnance) carried (which may, perhaps, be best shown by the number of tons displacement per ton of gun) is as follows:—English turret, first class, 56·1; broadside, 43·5. French, first class, 39·5; second class, 52·3. The advantage of the all-round fire of the turrets may enable the English ship to bring a great weight of artillery into action perhaps; but the question is, whether the greater number of guns carried by French ships may not be an advantage which must not be overlooked. So long as the medium guns carried in broadsides could not pierce our armour, the question was less serious than it may shortly become if medium new type guns are carried capable of piercing nearly everything we have afloat. No doubt we can hardly for a moment compare the "Admiral Duperré" and the "Inflexible." The 80-ton guns of the latter ought to penetrate the thickest part of the "Admiral Duperré's" armour, striking fairly, up to 2,000 yards' range; while the 46-ton guns of the "Admiral "Duperré" could not pierce the citadel of the "Inflexible." On the other hand, the English ship could in many positions only engage with two guns. The "Inflexible" is the bigger vessel by over 1,000 tons. The "Admiral Duperré" could, perhaps, compare better with







INJURIES SUSTAINED BY THE HUASCAR.
8TH OCTOBER, 1879.

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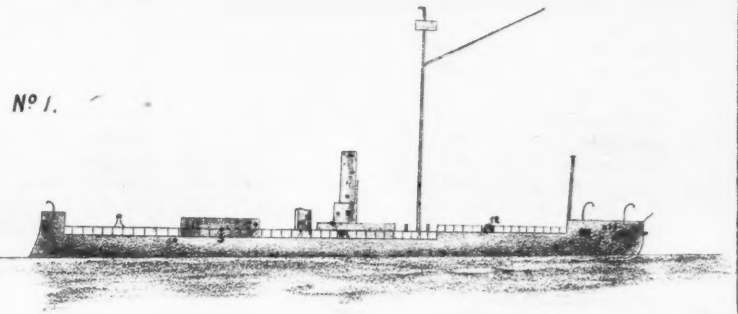

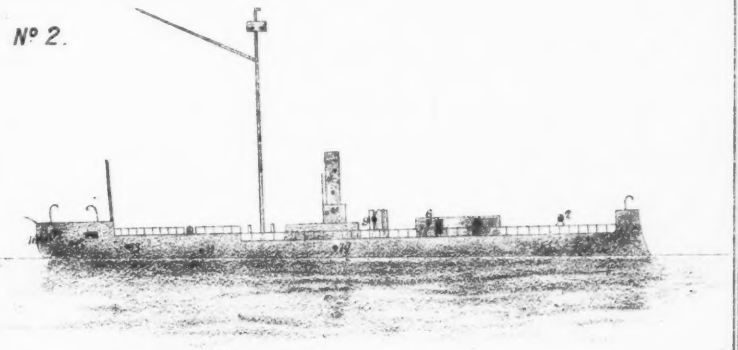

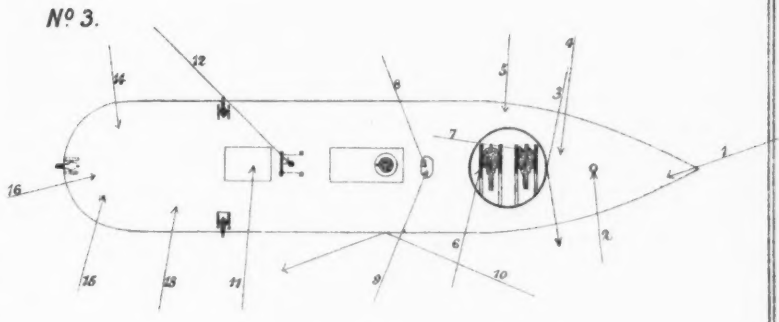

INJURIES SUSTAINED BY THE HUASCAR.
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the "Dreadnought," 564 tons bigger than herself, whose armour her heavy guns could readily pierce; but much better with the "Colossus" class, because her light guns would find work on the unarmoured parts, while her men would work in the barbette towers and behind the thin unarmoured iron sides of the ship with comparative impunity, owing to the small number of her adversary's guns. Sir William Armstrong, in his recent presidential address to the Institution of Civil Engineers, discusses the condition of a fight supposed to take place between one armour-clad and three unarmoured vessels costing the same sum of money. Sir William considers that the latter vessels would prove too formidable for their adversary if they were constructed so as to be almost incapable of being sunk, and also if they were armed with torpedoes. He even thinks that the effect of a shell entering the side of a ship is overrated.

I confess that I am unable to follow him in his reasoning, because while the ironclad would probably suffer very little from the *armour-piercing projectiles* of her adversaries, she might fire shrapnel and common shell at them, and I have instanced the sweeping effect of such projectiles on the battery of the "Shannon," to say nothing of the possibility of setting fire to them.

In the attack of harbours unarmoured ships would, I think, be almost useless. Forts are generally armed with numbers of guns which are almost powerless against armour, but it would be almost madness to bring an unarmoured vessel into the zone of their fire.

Sir William, however, reminds us of a type of vessel such as Elswick has supplied to China, which carries powerful ordnance and is so small as to present but a bad mark to an enemy. The spectacle of the "Inflexible," attacked by half a dozen such boats, and defending herself with her two pairs of 80-ton guns, and her necessarily limited supply of ammunition, would afford a painful illustration of power awkwardly employed. I think that she would feel the need of the medium new type guns which I have advocated in such a case.

It is not here denied that heavy guns have a special power of their own, in comparison with the same weight of lighter ordnance. Colonel Inglis has suggested one case, which deserves notice, when a heavy gun might effect more than many light guns, namely, against chilled iron armour. The French, Germans, Russians, Danes, Dutch, Spanish, and Portuguese have forts of chilled iron on their coasts. This material resists a good deal of heavy fire without suffering severely. It is employed on the presumption that at sea it is difficult for ships to plant many shot near the same spot. It appears likely that the blow of a projectile from an 80- or 100-ton gun might wreck a great portion of a chilled iron parapet entirely. However, this is a question of ships and forts, which certainly concerns our naval Officers, but hardly the English artillery, as it is difficult to imagine a case in which they would attack the coast batteries of European Powers, and we have no chilled armour on our own coasts.

With the object of inviting discussion, it may be well to draw one or two conclusions. It is therefore suggested, 1st, that at present we

need *medium new type guns* introduced as far as possible into the armaments of our ships and forts. Against *steel*, such guns are, in their measure, available for gradual destruction, and very heavy guns can only deal with steel in the same way, though much more rapidly, that is to say, they crack it to pieces, but do not actually pass on into the ship. Iron must be *punched*, and how well this may be done by a new type gun is seen from the fact that we found an 18-ton new type gun beating an old type one of 38 tons. 2nd, that the secondary attack of weaker parts of armour-clad vessels by common or even shrapnel shells deserves more attention than it has received. 3rd, high-angle fire at decks deserves more attention than it has received, especially as employed in the defence of harbours where, owing to the presence of submarine mines, attacking ships may be compelled to anchor. Lastly, it is suggested that we should guard against the disposition to take advantage of the small number of our guns by exposing detachments and confining armour to the vital parts, which form the natural object of attack of our heavy pieces.

Table showing how far the results obtained by the Rule of Thumb agree with those given on Colonel Inglis's Diagram.

Nature of Gun.	Calibre.	$\frac{W}{D^3}$.	At Maximum or Muzzle Velocity.				Penetration at 1,500 ft. Velocity.			Penetration at 1,000 ft. Velocity.		
			Velocity.	Penetration. By Rule of Thumb.	Penetration. By Diagram.	Difference, Rule of Thumb − Diagram.	By Rule of Thumb.	By Diagram.	Difference.	By Rule of Thumb.	By Diagram.	Difference.
100-ton Armstrong B.L.	17·72	·40	1500	26·6	25·3	+1·3	26·6	25·3	+1·3	17·7	16·1	+1·6
" " M.L.	17·72	·36	1735	30·7	28·1	+2·6	26·6	24·0	+2·6	17·7	15·3	+2·4
71-ton Krupp B.L. ..	15·75	·44	1653	26·2	26·5	−0·3	23·6	23·8	−0·2	15·8	15·2	+0·6
80-ton M.L.	16·0	·42	1613	25·8	25·2	+0·6	24·0	23·3	+0·7	16·0	14·6	+1·4
51-ton Krupp B.L. ..	13·98	·42	1650	23·1	23·0	+0·1	21·0	20·7	+0·3	14·0	13·1	+0·9
46-ton French B.L. ..	13·38	·39	1640	21·9	20·9	+1·0	20·1	19·0	+1·1	13·4		
38-ton M.L.	12·5	·42	1475	18·4	17·9	+0·5	..	..	..	12·5	11·7	+0·8
38-ton Krupp B.L. ..	12·01	·43	1650	19·8	19·7	+0·1	18·0	17·8	+0·2	12·0	11·3	+0·7
43-ton B.L.	12·0	·42	2005	24·1	23·9	+0·2	18·0	17·5	+0·5	12·0	11·1	+0·9
25-ton M.L.	11·0	·41	1410	15·5	15·0	+0·5	..	..	..	11·0	10·3	+0·7
26-ton B.L.	10·4	·41	2080	21·6	21·6	0·0	15·6	15·1	+0·5	10·4		
25-ton Armstrong B.L.	10·0	·40	2012	20·1	20·0	+0·1	15·0	14·5	+0·5	10·0		
18-ton M.L.	10·0	·42	1515	15·2	14·7	+0·5	15·0	14·5	+0·5	10·0	9·3	+0·7
17·7-ton Krupp B.L. ..	9·45	·42	1890	17·9	18·1	−0·2	14·2	14·0	+0·2	9·5	8·9	+0·6
18-ton B.L.	9·2	·41	2000	18·7	18·7	0·0	13·8	13·4	+0·4	9·2	8·4	+0·8
18-ton Armstrong B.L.	9·0	·34	2250	20·3	19·0	+1·3	13·5	12·1	+1·4	9·0		
12-ton M.L.	9·0	·35	1540	13·9	12·4	+1·5	13·5	12·1	+1·4	9·0	7·7	+1·3
$11\frac{1}{2}$-ton B.L.	8·0	·36	2040	16·3	14·9	+1·4	12·0	10·8	+1·2	8·0	6·9	+1·1
3·9-ton Krupp B.L. ..	5·86	·55	1664	9·7	11·5	−1·8	8·8	10·2	−1·4	5·9	6·6	−0·7
5-ton French B.L. ..	6·28	·40	1738	10·9	10·7	+0·2	9·4	9·1	+0·3	6·3	5·7	+0·6
4-ton Armstrong B.L. ..	6·0	·37	1960	11·8	11·2	+0·6	9·0	8·3	+0·7	6·0	5·3	+0·7

The Rule of Thumb gives the best results when V=2,000 feet about, and $\frac{W}{D^3}$ = ·41 about.

The CHAIRMAN: Captain Browne is very anxious that this paper should be fully discussed. We shall be happy to hear any gentleman who has any observations to make.

Captain CURTIS, R.N.: With reference to unarmoured vessels carrying guns attacking armoured vessels, I believe it was found in the French War that if a vessel of very little power attacked a stronger one, and was taken, he was treated without mercy for incurring a reckless loss of life; and I think inferior vessels attacking a very superior one in all probability would meet with the same fate. Therefore, I do not think that is the correct policy. I have read in the papers lately about the protection of our commerce, and it appears to me that our merchants are led to suppose that in case of war commerce would have to protect itself. I do not wish to speak disrespectfully of the Admiralty, but if they provide them with guns and so forth it is very much like saying to Englishmen. "When you are invaded you "must protect yourselves," by putting rifles into their hands.[1] I think ironclads will, or should, be engaged against foreign ironclads; and with respect to our merchant ships, they can only protect themselves against similar merchant ships armed by foreign Powers. It may be a satisfaction to know that a friend of mine lately came from Vancouver, where he entertained the Russian Admiral, and the Russian Admiral rather laughed at the vessels which they had bought from America, for, although they were strengthened, they were afraid to fire their guns, and they had small guns for saluting. I do not think it is policy for light armed ships to attack armoured ships. I perfectly agree with the lecturer that light vessels ought to have the heels of the armour-clad, and I think when we meet a superior force "discretion is the better part of valour."

Commander W. DAWSON, R.N.: We never listen to Captain Orde Browne without learning a great deal of the details of our profession, for which we must be very thankful to him. I am sure he will go with me in saying that the experiments put before us are simply valuable for comparative purposes as between one gun and another, or between one kind of armour and another, but that they are not to be relied upon as representing at all what takes place when the gun is brought into action against an actual ironclad ship. In nearly every instance in the experiments before us it is assumed that the armour is penetrated at right angles, and there is also a large assumption that the shot does strike the armour, which is a very large assumption with reference to naval warfare, in which only one shot in fifty is an effective hit. It is a comfort which we may take to ourselves when attacked behind armour, that the guns will not perform in action as they do when attacking a mere shield, because most of the shot will fail to strike, and the few that do so will strike obliquely, and so will not penetrate to anything like the depth which they might be supposed to do according to the rule which Captain Orde Browne has put before us. I think his practical rule ought to be amended, so as to include some allusion to oblique hitting, because the greater part of the shot that hit us would be either vertically or horizontally oblique. We have very little experience of British guns firing against foreign ironclads; the only example, I think, is that of the "Huascar," when the "Amethyst" and "Shah" attacked that vessel. The old rule in firing was that the gun's weight in shot was required to kill one man. There was one man killed on board the "Huascar." The heaviest British gun attacking her was a 12-ton gun, and so it ought to have taken twelve tons of shot to kill that man, but it took sixteen tons. Therefore we must not be discouraged by thinking that the guns are going to do in action all that they are represented as doing at a target. It was my fate some nine or ten years ago to bring before the notice of this Institution the weak penetrating powers of British guns, and also their lack of endurance, as well as their small shell power. The result was a private Departmental Committee to enquire into these allegations against British guns. I did not know of this Committee till some time after it had

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[1] We require something besides the guns—men that know how to work them. Surely out of an approximate number of fishermen and boys of 125,641 we could raise a reserve force for any emergency. See "Fishermen's Almanack" for 1882, by O. T. Olsen, F.R.A.S., F.R.G.S., of Great Grimsby.

decided, when I was told the Committee had determined to whitewash the guns. British guns were accordingly whitewashed for a time, but I am glad to see by the table brought before us to-day that the whitewashing has not been very durable, and that at last it has been washed off, and that sailors are promised in the future guns that will give not "*decidedly the lowest velocities*," which was the official report of the then Ordnance Select Committee upon the so-called Woolwich system when it was first introduced in 1865, but will give as high a velocity and as hard a hitting power as any foreign weapons. That will alter the case as to British guns against foreign ironclads. Still, looking at the prevalence of oblique hitting, it strikes me that the primary attack as Captain Orde Browne spoke of it will sink even more into the background than he has put it, and that the secondary attack will be more frequently successful. It is on these grounds that I have always held it very important that ironclads should have, besides their protected armour-piercers, a number of smaller guns in order to destroy the ends and pierce below the water-line. When ships are in vertical motion at sea, piercing the ends may let in the water, and sinking one extremity may so raise the other end out of water as to make it easy to hit below the water-line; so that the partial defence by ironclad patches, or even by submerged decks, may not, perhaps, be so successful as is expected. That point of increasing the offensive powers of ships by increased velocities of shot, and by multiplying guns, is one I have always advocated in this Institution, and I am very happy to see that Captain Orde Browne has taken it up in his present paper.

Captain P. H. COLOMB, R.N.: I have always been accustomed to consider that the target offered by an ironclad is divided into three parts, which I have usually called the vital target, the effective target, and the ineffective. The vital target is some space near the water-line, according to the state of the sea, at which you might suppose if struck by a shot a vital injury might be done to the ship, in point of fact, you might sink her. The vital target is also that part containing the machinery, where a single shot might destroy her propulsion; also that part containing the steering gear, where a single shot might destroy her manœuvring power. Then the effective target I suppose to be that part of the ship where the fighting power is contained, where the men are. You might, of course, destroy the ship by operations on her vital target, but you might capture her by operations on the effective target—by the destruction of her men, and the fear of greater destruction induced thereby. Then, lastly, you have the ineffective target, and, as I understood the lecturer, he did not seem quite to draw a complete distinction between the ineffective target and the effective target. Because, when you concentrate your men in the protected parts of the ship, your enemy can do almost no damage whatever by his light guns on the ineffective part of the target, as it does not hurt the floating power of the ship. There are no men to hurt, and the only damage you can do is in setting fire to the woodwork. Of course, we are gradually decreasing the woodwork, and so that danger of fire passes away. But I very fully agree with the lecturer in the attention he draws to the fact that a ship with very few heavy guns, incompetent to pierce the plating of an adversary, is not in a good condition. She is open to the attack that Sir William Armstrong speaks of, and the more I think of it the more satisfied I am that that attack will be developed by numerous small unarmoured vessels, which can be cheaply built, and whose shot will be effective on the hull of the ship carrying the few heavy guns. I should like to see some method given to us of comparing gun with gun by some still more general and readier rule than that which the lecturer has given us. I should like very much to see an established distance taken—500, 200 yards, whatever it might be—and that we invariably spoke of the power of a gun in inches of iron capable of being penetrated at right angles at that range, so as to have a general standard of comparison. I find it myself exceedingly difficult to compare gun with gun by reason of the various measures of power which are given. The lecturer, in one of his sections, spoke of the "Huascar" as keeping her stern away from the enemy systematically. I can only say I did not gather from such study as I have made of that section that she did that; it seemed to me that she simply made away from her adversaries, who overpowered her six to one. They had twelve guns to her two, and it seemed to me she simply made away from them to the very best of her ability without any tactical views whatever. The lecturer drew attention to what appeared to him to be a

discrepancy. The Director of Naval Ordnance, in writing on the "Inflexible" in 1877, said: "The projectiles that would be fired at the 'Inflexible' would "certainly be armour-piercing, either chilled iron or steel; and such shell would "not burst in passing through the thin iron sides of the ship, as they require the resist- "ance of armour to ignite the bursting charge." And then the Committee wrote: "The most effective armament to bring against the 'Inflexible's' ends alone would "undoubtedly be one of numerous shell guns." I do not think there is any discrepancy in the two things, the point being that the Director of Naval Ordnance did not think it was any use firing at the ineffective target formed by the "Inflexible's" light ends, and the Committee thought that if you did fire at those light ends, the proper course to pursue was to get light guns to bear upon them. There is a peculiarity about the "Admiral Duperré," and some of the French ships, which I do not think is fully noticed. When I tried my hand at a little ship designing I came to the conclusion that we were omitting in our designs to adopt a principle which had many good points about it; that was, to armour a little above the water-line down to whatever depth might be needful, to join with horizontal armour the upper edges of this vertical armour, to have a clear space over it through which the shot might pass, and then to mount your battery, where you put your men, above this clear space. Then you would have your vital target at the water-line, your ineffective target the whole length of the ship under the battery, and the batteries themselves the effective target. In the "Admiral Duperré" you have very nearly that; and, except where she mounts her light battery, the shot can pass harmlessly through. If the horizontal armour joins on to the top of the vertical armour on the ship's side, and the shot would pass under the barbette battery, doing no harm, she would have a very large structure and a very small effective target. I think the lecturer confirms the view that is beginning to be more and more strongly held, that is, the necessity of a double armament in all ships without exception. This is done in the "Admiral Duperré," and it is still more carried out in the Italian ships "Italia" and "Lepanto." I think that it will go on and develop, that we shall have one or two heavy guns for the purpose of attacking the citadels of ships, and a continually increasing battery under armour, I believe, too, under lighter armour, of lighter guns for the purpose of attacking the effective target.

Colonel INGLIS, R.E.: I did not come here with the intention of saying anything to-day, especially as the subject is mainly that of naval construction, on which, of course, I do not presume to have any opinion; but as I have been quoted in the matter of tables of perforation, and as Captain Orde Browne has mentioned his "rule of thumb," I may just say that I quite agree as to the utility of that rule, and generally with its correctness, but I had previously given a similar rough formula. Captain Orde Browne's rule gives rather too low a velocity for the perforation of plates of thickness about equal to the calibre of the gun. I think he will find that it will not do to take the velocity so low as 1,000 feet for a plate equal in thickness to one calibre of the gun. I find it comes out between 1,050 and 1,150 velocity, and for one and a half calibre thickness of plate to between 1,500 and 1,600, and for the two-inch calibre it would be more correct to put it at 2,000 to 2,500 feet; the discrepancies are no doubt due to the shot of all guns not being of uniform weight in proportion to the calibre, that is to say, the value of $\frac{W}{d^3}$ varies very much in different shot. If that were uniform in all guns Captain Orde Browne's rule would be nearly true. It is not a very important point, but I should like to mention something with regard to the Meppen experiment referred to by the lecturer. I have been long interested in the matter of what is called the sandwich construction, that is, where, instead of having one solid thickness of plate, we use two thicknesses, and fill up the intervening space with softer material. The target at Meppen was a sort of imitation of our sandwich targets, but it was not a good target, and it has given rather a fallacious idea of the value of that kind of construction. I think you will find that it did not offer anything like the resistance that one of our targets would have given. It consisted of a 12-inch iron plate with an 8-inch plate behind it, and 3 inches of wood between them. That is not a good arrangement to begin with. I think I should put the 8-inch plate in front of the 12-inch, or perhaps not adopt those thicknesses at all. In the next place, the intervening

thickness of wood was by far too little, and, further, the back plate was a bad one. I do not know about the quality of the other, but, judging from the photographs I have seen, the back plate was decidedly a very indifferent one. Also the method of holding the two plates together was altogether wrong; in fact, I do not gather from any account that I have seen that they were held together at all. If we had to make this target, using English armour-plates, it would just let the shot employed at Meppen through and no more; so that here we have the difference between a good and bad target represented by 3,500 yards of flight of shot through the air; so great is the difference between a properly constructed target and one of inferior construction and material. I do not know whether it would interest anyone to hear how I constructed the curves of penetration of shot referred to by Captain Orde Browne. It was, shortly, on this principle: I observed in a great many rounds fired at Shoeburyness that for a given proportion of thickness of plate to diameter of shot, there was a constant amount of energy required to displace a unit mass of plate. I, therefore, took from actual results what was the amount of foot tons of energy necessary to remove, for instance, a cubic inch of plate when the diameter of the shot and thickness of the plate were the same; that gave one constant. Then I took the same for other proportions of diameter of shot to thickness of plate, and found for each the energy necessary to displace a cubic inch of plate. By that means the velocities under various conditions were obtained, and so I was enabled to lay down the curves of penetration of plates of all thicknesses by shot of all guns. I also thought it was desirable to show what perforation of iron each gun would do at all points of its range; and my tables show this for all ranges up to about 8,000 yards. One thing strikes me that ought to be mentioned in regard to the experiments at Spezia in 1876. These trials were on a very large scale, and in many respects were very important, but the results were much invalidated, I think, by the narrowness of the plates that were used. Thus, although one can derive some information from them, still they would have been much more valuable had plates of better proportions been employed. It should always be remembered that a big shot requires a wide plate; otherwise it will break it asunder without meeting with much resistance.

Vice-Admiral SELWYN: I think I must ask Captain Orde Browne if he does not consider that the great advance made within the past few months, both in armour and in guns—the strength of the guns and the resisting power of the armour—would considerably interfere with any calculation that he could make from the existing state of things; since we learn that by the so-called "compound armour" (a name originally given to a totally different structure), that is to say, armour-plates faced with steel, we have arrived at a resistance which enables us to diminish the weight of the plates by one-third. In the case of the guns, I do not quite understand what he calls the "new type gun," whether it be a gun as advocated now by Sir William Armstrong, and as originally devised by Captain Blakeley and Mr. Longridge—the steel band gun—of which we have no very correct knowledge, but we know at least that it is so very much stronger that it may be made very much lighter and give the same results. And all this must necessarily go still further if, on the one hand, the guns should turn out to be so much stronger as to permit the employment of a quicker burning powder without any disadvantage, but the contrary; and if, on the other hand, the indications given by steel-faced armour of the present day be followed to their legitimate conclusion. I am disposed to think very strongly on the subject of steel-faced armour, because it is now some ten or twelve years since I first advocated its use at the Institution of Naval Architects on the analogy of the anvil, but I do not think this has been considered completely in the so-called armour-plate of to-day. A plate of two inches of steel does not really represent the physical conditions necessary in an anvil, or in any structure designed to resist severe impact. We must consider that the anvil receives the blow at first on an elastic material. The steel is carefully tempered when put on the anvil, and it distributes the blow to a mass of cast-iron whose molecules will create a cone of dispersion, and spread the force of the impact. Then the tendency to disperse so created is controlled by the exterior wrought-iron casing of the anvil. We have nothing like that in the case of a compound plate, as now made, yet that is undoubtedly what experience

teaches us as the best way of receiving and distributing a blow without damage to the structure, but it is not yet worked out, and I hope to see some experiments made with a view to doing so much more accurately and largely than has yet been the case; the results hitherto obtained being extremely encouraging. If we could afford to diminish the weight of armour carried on our ships' sides, and the weight of the guns, then it would be perfectly practicable on the one hand to increase the area covered by armour, and the thicknesss of the armour in what has been called the vital target; and we could on the other hand carry more guns, which seem to be very much required in the present day, without materially increasing the weights, for we must recollect the problem of the naval architect is how to carry an enormous number of weights of very great localization high up in the ship. How is he to provide sufficient buoyant power? The more those weights are distributed the more easy will be his task; in the one case because damage to any portion of the guns does not entirely destroy the offensive power of the ship, and in the other case because great weights if distributed over a large amount of surface are more easily so arranged as not to make the ironclad, what she unfortunately now is, a vessel unable to incline 45 degrees without turning bottom up. We say to the naval architect—"We wish "you to do something better for us," but Sir E. J. Reed tells us that in the vessel built for Japan you have the only ironclad that could be inclined to 45 degrees without turning bottom up. We shall, I have no doubt, have to fight an increased power of guns: Captain Orde Browne has shown that. He is one of the gentlemen attacking ironclads, of course we occasionally do so, but an artilleryman looks upon an ironclad as a nice little target which he has to pierce, and he takes the greatest delight in proving that his guns can pierce it. But I must tell him we have a resource which he has not taken into consideration, namely, that we can go so low into the water that he will have no target at all, and that when he has got his gun to its highest perfection, and can hit a fixed target at four miles distance, which I should think a very difficult thing to do with any ship afloat, and under way, then we shall have to go under water, or at least we shall have to go so much below water with our men and crew, and with all of what Captain Colomb so well called our vital target, that he will no longer be able to assault us with any fatal effect at all. Naval Officers look more to the improvement in armour than in guns, since of late years they have had several very efficient weapons given them for attack under water; and as to the artillery fire, they think that however good an artillery-man might be at his work, he is not likely on moving ships to be able to get quite as good a result as he shows on those diagrams. I may mention that Hobart Pasha during the late Russo-Turkish War went to inspect the defences of Sebastopol. He advanced within the zone of fire, and, as it appeared from the flashing signals that the harbour was no doubt plotted out, he put his helm down, and told me that he happened to put his helm down at the moment when they fired all the guns together at him, and the whole of the 35-ton shot fired at that moment plunged into the water in one mass within 100 yards of the stern of his ship. Had he been proceeding in a direct line, instead of putting his helm down, there is very little doubt that every one would have fallen on his deck. This shows the danger we may incur in running into a harbour plotted out in that way; but I hope naval Officers will consider that a fort is a thing to be avoided—that you can do very much more damage by not attacking a fort than by attacking it—and had better keep your offensive powers for some foe more likely to suffer by your action. Probably an undefended commercial port would suffer very considerably from an ironclad, and I am sorry to say in our own country, as well as in others, there are a very large number of practically undefended commercial ports, where any ironclad running in would at the present moment have her own way entirely until an iron-clad could be telegraphed for to go to that particular port to meet her. Now I come to the part of the discussion which has touched on the subject of having many small vessels; and I want to point out what an enormous advantage it would be to this country if those large guns could be set afloat on moderate sized and moderate drafted vessels in such numbers that we could have a great many of them in each port. I would not confine myself to one or two, I should say ten, carrying each the heaviest gun that can be put afloat. There is no reason why you should not do this,—it is perfectly possible. If you will consider that we might have

twenty such vessels with twenty 80-ton guns to go to the attack of one ironclad coming in with four 80-ton guns, I think, as she can only fire those four 80-ton guns at four out of the twenty ships, at a time, she will be very thoroughly punished before she gets rid of her mosquito antagonists. Add to that the power of torpedo launches, and I think it will be found that we ought to turn our attention much more persistently to the creation of a mosquito fleet around our own shores: if we are to carry out the policy of "Defence, not defiance," we should pay less attention to the creation of types of vessels which cannot be made to serve their purpose directly there is an improvement made in guns or armour. You cannot profitably pull them to pieces, and the result is you have to say that others must be built as soon as possible. There never will be any finality in the combat between the gun and the armour until both disappear from the field altogether, so that these mosquitoes of which I speak, inexpensive, always on the spot, not to be telegraphed for to go round to find the adversary gone away, but always ready and employing your naval volunteer artillerymen in learning work for which they would be much better fitted if they had a few of these boats in their ports. Thus they would be practised with real guns and vessels such as they would be called upon to use, while at present the practice is very little in accordance with what they would have to do in case of war. I hope to see this lecture followed by others. I must say that it has been of great advantage to this Institution to have this lecture, and I think it will be of greater advantage to this Institution to have it followed up by gentlemen giving each detail; one taking the armour,—I hope, supplemented by experiments which might be made very cheaply and efficiently by the Committee, another taking the progress of the gun, and keeping the Institution thoroughly informed on these subjects. We hear from the papers a great many things which are quite unreliable; we know in the Institution comparatively little of what is going on outside, and it is most desirable that Officers of both Services should be kept posted up to the day, for we do not know how soon our services may be called upon, and if knowledge might have been had previously, the whole nation would have cause to regret that it was not available at the moment it was required, but had then to be sought for, when neither time nor means could be spared to acquire it.

Mr. WHITE, Chief Constructor: I did not intend to say a word, but Admiral Selwyn has made one statement which I cannot allow to pass without contradiction, not wishing, of course, to contradict his accuracy in repeating what he may have heard. I wish to say that it is not right to assert that no ironclad in the Service can be heeled over to 45°, and return again to the upright. There are many ironclads in the Service, most of them now lying in the harbours, which have at sea rolled over to 45°, and yet they did come back to the upright. I think these somewhat sweeping statements about the stability of the ironclads might be at least examined with reference to publications which are available to every one before they are repeated. If this were done it would be seen that the range of stability of the ironclads is not anything so small as 45°, but a great deal beyond in all cases, except those of vessels built especially for smooth water service along the coast. The facts which I speak of will be found in the Report of the Committee on Designs in 1871; that is all I wish to say upon that point; it is rather an important one, as this discussion, I presume, will be printed. I did not have the pleasure of reading the paper or of hearing the earlier part, and therefore I would ask Captain Orde Browne if his remarks as to the slow destruction of steel armour by comparatively light guns are intended to apply to steel-faced armour, such as we are using in the ships of the Navy? I may say, for the information of Officers in the Service, that our test for these steel-faced armour plates is this: we take a plate 8 feet by 6 feet, which is from 9 to 11 inches thick. This plate is placed 10 yards off the muzzle of a 9-inch gun, and three shots are planted upon it in the form of an equilateral triangle, the sides of which measure about 21 or 24 inches. That is to say, in a plate 48 square feet in area, we deliver three closely placed blows from the 12-ton 9-inch muzzle-loading gun, and we are accustomed—I am speaking now of mere matters of fact—to get steel-faced armour which successfully resists that amount of punishment. When we take a plate down, it commonly has no crack on the iron back and no sign of detachment of the steel face from the iron back. In view of these facts, it is obvious that when we hear of steel armour crumbling away under the fire of com-

paratively light guns, that is not the kind of armour which is being put on English ships-of-war. Another word I may be permitted to say, as the subject is one in which I take very great interest, although only as an outsider, on the artillery side. It seems to me that Captain Orde Browne preserved a singular silence as to the possible effects of artillery fire below the armour belt when ships are rolling at sea. I hold that in comparing the efficiency of war-ships, steadiness in a sea-way is of immense importance, and if you have two types of ships armoured to the same extent below the water, one of which is much steadier than the other, that quality surely must be reckoned as a substantial advantage. It also must be held to be true that since there are very few ships in which the armour goes more than 6 feet below the load-line, there must be a chance of artillery doing damage under water as well as above; in a part of the vessel which I presume Captain Colomb would include in his vital target. The difficult problem we have to face as naval architects was very clearly put by Admiral Selwyn, and I am thankful to him for having put the case. We are continually being called upon for ships of moderate size, with high speed, carrying heavy guns, many light guns and machine-guns, thick armour, torpedo armament, possessing great handiness. Every desirable quality is asked for in a ship of moderate size. That is all we are asked to do; it is a very modest request, but our lives are made a burden by being asked to do so many things—and always in ships of moderate size. If any gentleman can invent armour or guns that will enable us to associate greater power of offence and defence with less weight, we shall be extremely grateful.

Admiral Selwyn: I may explain that I quoted Sir Edward Reed on this subject; I did not give my own figures in speaking of 45°.

Captain Browne, in reply, said: The first question I ought to notice is that put by Captain Dawson on the limit of penetration. I did not mean to say that the shot generally would penetrate the amount that I gave by the rule of thumb, but what I was pointing out was that in iron armour you should know the *maximum* your guns can do, and I think that that limit is about the maximum. There are one or two cases of Krupp guns where the weight is very great in proportion to the calibre, and the guns may do a fraction of an inch more; but it is so extremely unlikely that a gun will do even its maximum on conditions of service, that you may take this approximation to the maximum as certainly the *limit*. I was endeavouring to fix a distinct limit with reference to wrought-iron armour, at which you may say "It is no use my endeavouring to penetrate that armour, I may "give it up altogether." An Officer would not be justified in giving up the possibility of penetrating a ship unless he had clear ground for believing that it was impossible. Now, if you find you have not got 1,000 feet velocity for every calibre of your guns, you may say that *perforation* is impossible. For example, if a ship has 9 inches of armour, and you have 9-inch guns, a 1,000 feet velocity may possibly do, but if you have not got that you may give the primary attack up with a thoroughly good conscience and take to the secondary. That was the limit I was endeavouring to fix, and I think Captain Dawson would not disagree with that. With regard to the division of the ship into three targets, the only doubt that I should have about such a ship as the "Admiral Duperré" would be whether practically you could have an effective target and a vital target with an entire space in between, which is called the ineffective target. For I question, if that ineffective target were shot away to a great extent, would the effective target, which must be of a considerable weight above, be capable of supporting itself? This is one of the points that I think comes out in the construction of ships, namely, how far it might be possible to capsize armour of a certain weight fixed on comparatively weak supports above the deck. It seems to me that that may happen if you have the effective target above the ineffective target. In firing at the "Inflexible," I admit if the ship engaging her had a single gun heavy enough to be able to pierce her armour, then I can understand the Director of Naval Ordnance saying the most effective attack would be the primary attack, and that would be consistent with what the Committee said as to shell-gun fire at unarmoured parts. But it is so very seldom you would have guns capable of piercing the citadel of the "Inflexible," that I think it remains probable that the most effective attack would be that of the unarmoured part. With regard to the "Huascar," I stated, I believe, that she

kept her stern away from the enemy. The authority I quoted was King's account, page 440, where he states that, seeing escape was impossible, the commander of the "Huascar" ran his vessel as close to the shore as possible, keeping her most vulnerable part, the stern, away from the enemy. I only quoted it from that, and you must take it for what it is worth.

Captain CURTIS: It is stated in the Journal of the Institution that her steering gear was three times disabled.[1]

Captain BROWNE: With regard to the double armament, I was glad to hear that noticed by a naval Officer, because it appeared to me to be necessary to have an armament capable of engaging unarmoured antagonists. With reference to the rule Colonel Inglis spoke of as my rule, I do not lay claim to that rule, I noticed it for myself and found that it admitted of mathematical proof, but it had been observed, so I hear, by others. I believe that that rule could never come quite right for thin armour such as one calibre of thickness, no matter how the shells might be proportioned. I noticed that the rule appeared to run right for a great number of experiments, so much so that I tried how it would prove mathematically. That proof depends on two things: one, the proportion the weight bears to the calibre; and also the resistance of the target being as in proportion to the square of its thickness. Now, the resistance of the target becomes most nearly proportional to the square of its thickness when the target is *thick*. You can see mechanically that, as the target increases very much, there is a much greater mechanical resistance to a projectile than when the target is thin in comparison with the shot, and eventually there comes a place about which the proportion runs up and down nearly as the square of its thickness. When the target gets very thin the rule fails. I only mentioned it as a rough rule, happening to be most nearly correct under the circumstances, which are most important when you are firing with the maximum power of your guns at thick armour. Colonel Inglis mentioned his rule. I think it is undesirable here to go into mathematics, you cannot do it satisfactorily in a discussion of this sort, but I may point out that his rule, under the conditions in which it is found to be accurate (the condition in which he does not alter his constants) is precisely the same as the old rule employed in the Department of the Director of Artillery. This is a thing that admits of mathematical proof, and I am prepared to say that Colonel Inglis's rule, under the conditions in which he does not change his constant, is absolutely the same thing as the other rule. Colonel Inglis's formula makes the resistance a sort of resistance due to inertia, and proportional to the volume of the disc of plate removed by the shot in perforation, that is $\pi\frac{d^2}{4} \times t$, where d is the calibre and t the thickness of plate. The old formula treated it as a resistance due to cohesion, proportional to the circumference sheared away and multiplied by the square of the thickness. That is to say, Colonel Inglis's was—

$$\frac{Wv^2}{2g} = c_1 \pi \frac{d^2}{4} \times t \quad \ldots\ldots\ldots\ldots (1),$$

and the old formula

$$\frac{Wv^2}{2g} = c_2 \pi d \times t^2 \quad \ldots\ldots\ldots\ldots (2),$$

c_1 and c_2 being constants. In point of fact, all constant parts of any expression may be included under one constant, say K, and determined by practice once for all. We need only consider the variables. Hence we may write these two equations (1) and (2)—

$$\frac{Wv^2}{2g} = Kd^2t \quad \ldots\ldots\ldots\ldots (1),$$

and

$$\frac{Wv^2}{2g} = Kdt^2 \quad \ldots\ldots\ldots\ldots (2),$$

in which the only difference consists in (1) containing one power of d instead of the

[1] See "Journal," No. CXII, p. 699.

power of t contained in (2). But Colonel Inglis only applies his rule rigidly to cases when t bears some fixed relation to d. Whenever this relation changes, he changes his constants. So that Colonel Inglis's rule rigidly applies only to cases when it becomes immaterial whether t or d be used, for the constant relation may be disregarded as part of the K, which is to be determined by practice, and the two formulæ becomes thus identical under these conditions. I will not go into the case when Colonel Inglis changes his constants. I think it is satisfactory when you see formulæ arrived at in different ways coming practically to the same thing. I believe what Colonel Inglis says about the rule of thumb; undoubtedly he gave you more accurate rules in his diagram. I did not endeavour to give an exact results; I only endeavoured to give some extremely simple general principles, which was good enough for practical purposes. It is very difficult to remember rules of thumb if not very simple, and I find I can remember the rule "a thousand feet "velocity gives the calibre of penetration." With reference to the Meppen target, I think you can see from the drawing that it was an indifferent plate—the front target may have been brittle. I think I was told that it had phosphorus in it, which would have inclined to make it rather brittle. Of course, in accounting for power of penetration, when you have calculated the stored up work in the projectile, and the size of the projectile, you know you have got the whole thing. There can be no magic in the projectile. I suppose then that one cause of the penetration may be that the plates were made of indifferent iron. Another reason may be the fact that the point of the shot was sharper than that on which most of our calculations are based. It was a 2-diameter point, and I think there is something due to that. I believe for direct firing, there is no question the sharper the point the better. The third thing I suppose was that the target may have been badly made. I should not have thought that the plates not being bolted together would have given better penetration, though I should have supposed it would have made them bend more easily. Colonel Inglis, however, I see signs to us that it would actually give more penetration. With regard to what Mr. White said with reference to steel fronts, I did not mean that our steel-faced targets would behave in the way in which the solid steel targets behaved at Spezia. I do not believe they would behave in that way at all. I believe they have mainly the toughness of the back with what hard surface you may put on to break the shot, with the mechanical advantage which is obtained by pressing against a point before it enters the plate, but I believe it does remain true in a very small degree, that the advantage which is possessed by the compound target compared with the iron does not hold good for repeated firing to the same extent that applies to the case of a single blow, judging from the report of the Committee on Plates and Projectiles. They speak of 10 inches of compound armour being as good as 12 inches of wrought-iron for a few blows. I think you sacrifice something of the power to resist an enormous quantity of firing in having a compound front to the armour. With regard to 6 feet below water, I should have thought that a ship with armour extending 6 feet below water could not have been struck by artillery below the belt. If you take the probable angle of descent of the shot, and then take 6 feet under water, and draw a line, you will see it has to go through a tremendous quantity of water.

Mr. WHITE: I was speaking of where the armour came out of the water.

Captain BROWNE: If the armour had come entirely out of water, of course you might possibly strike it. I should have thought few vessels could have engaged to much purpose when there was such a roll on, but that is a naval subject. To finish up, with reference to these Chinese boats, I think there is no doubt the question that has been touched on with reference to the mosquito fleet is an extremely serious one. I had a question put to me some time since by Sir Henry Gordon as to what the guns of the Chinese boats would do against such a ship as some of our first-class broadside ships, such as the "Swiftsure." I believe that they carry guns that would pierce the armour of any of our broadside ships. Those vessels would of course be extremely formidable, because they would trust to their small size; they would come in number, and perhaps keep a considerable distance, and we should then need to have an auxiliary armament of light guns to our turret-ships. I think Admiral Selwyn gave the "Inflexible" credit for firing at four adversaries, but it seems to me she could only fire at two, and that was why I

took the case of six vessels engaging her, and being able possibly to hold their own, and annoy her.[1] I do not think there was any other thing that was noticed. I am not particularly defending anything I have said, because the object is to discuss this, and I am not putting forward any very distinct views. I have, however, put two or three questions forward at the end of my paper, and it appears that they are generally agreed to, namely, 1st, that we want a second armament of medium new type guns; 2nd. I also noticed the necessity for mortar fire, and the reason I did so was because Admiral Hornby, in the discussion that followed at Woolwich, spoke of vessels engaging at anchor. I was under the impression that vessels would not have engaged at anchor. I thought they would have followed some sort of elliptical path, and engaged in motion. But I now believe that there were instructions given at times to our ships when war was threatened, to clear a small space of water of submarine mines, and then to engage forts at anchor. It is only the case of a ship engaging at anchor that would make me suppose you could bring any high-angle mortar fire to bear, but if you have a harbour laid down in squares, and ships then clear a certain square of submarine mines, and proceed to engage forts at anchor, it seems to me the most effectual way of attacking them is to have mortars or howitzers that bear on that place, and if they fire with one-tenth part of the accuracy of Krupp's mortars at Meppen, they would be extremely formidable.

The CHAIRMAN: We have had a very interesting paper, and I think I may say a very interesting discussion. It only remains for me in your name to thank Captain Orde Browne for all the facts he has brought before us. He has evidently taken great pains with this lecture, and I trust that on some future occasion he will favour us with some other views.

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[1] The "Inflexible's" supply of heavy ammunition is necessarily limited, and much of this would be wasted quickly in such an action.

[2] As can be done on Captain Watkin's system.

Friday, January 20, 1882.

LIEUTENANT-GENERAL ARTHUR J. HERBERT, C.B., Member of Council, in the Chair.

BRITISH MILITARY POWER CONSIDERED WITH REFERENCE TO WAR ABROAD.

By Colonel H. B. H. BLUNDELL, Grenadier Guards.

THE object of this lecture is to urge that the action of steam cruizers upon an enemy's mercantile marine in naval warfare has entirely changed the conditions of great wars as they affect Great Britain. That, as a consequence, the idea which obtains of the military effort England would have to make in such a war is inadequate, and that an alteration in the establishment of regiments and changes in the conditions of reserve service are desirable.

First, as to the resources of the British Isles:

The population is 35,000,000, concentrated upon a comparatively small area, which is intersected by a most complete system of telegraphs, railways, roads, and other communications.

The wealth and manufacturing power—especially the manufacturing power of war *matériel*—of Great Britain is greater than that of any other nation, and her maritime preponderance as compared with any other Power is not only to be measured by the relative strength of their respective fleets, but to some extent by that of their merchant navies. It is stated that 70 per cent. of the sea trade, and two-thirds of the steam tonnage of the world, sails under the British flag. The arrangements for manning the British Navy do not, however, appear satisfactory as contrasted with the obligatory enrolment for maritime service of their seafaring population by other Powers.

Thus with a population which may almost be spoken of as approaching that of France or Austria, and as nearly double that of Prussia in 1866, the great *latent* power of England is indisputable, and so long as superiority at sea is maintained over an enemy, *time* is given to render that latent power *active*. For *time* all-important, Great Britain depends upon her Navy.

The military forces which would be available immediately on the outbreak of hostilities, although by no means despicable as against invasion by what may be termed *coup de main*, are very small indeed as compared with the *latent* resources of the country; while the army available for immediate action in an European war might even be

regarded as insignificant, but for the power of choosing and of changing the line of its operations which the command of the sea frequently gives to a British force making war in a continent of peninsulas such as Europe is. This power largely increases its numerical effect.

In order to estimate the war-effort which the British nation could make in a contest of vital importance, it appears useless to refer to recent wars in Western and Central Europe.

Since the necessities of Prussia at the beginning of the century taught her to train her men to arms in relays, and to hold them ready to return to the ranks when summoned, and since an admirable administrative system has enabled her to collect, organize, clothe, equip, feed, and move the national forces so summoned, the nations on her borders, unless equally ready to place the bulk of their national forces on a war footing on the outbreak of hostilities, have been liable to be overrun, overpowered by superior numbers, and paralyzed before they could organize their forces.

In Central and Western Europe, then, *latent* force, no matter how great, is useless to a nation, and the relative strength of contiguous Continental Powers can only be contrasted by comparing their actual forces and their military systems.

America is not, however, so circumstanced; her isolated situation, like the insular position of Great Britain, still gives her *time* to organize her forces, and enables her to dispense with the military systems of the Continent; while her system of Government, theoretically as free as that of England, is a guarantee against a premature resort to compulsory service in the Army.[1]

A brief review of the war-effort made by the Federal States during the American Civil War probably shows what would happen here were England engaged in a national struggle, more correctly than the review of any other war or any speculation on the subject could do.

On the Southern States taking up arms, and Fort Sumter capitulating, President Lincoln first called out 75,000 militiamen for three months, unless sooner discharged, by requisition to the States, for the proposed object of putting down the rebellion.

It soon became evident that large levies were needed: Congress, meeting in extraordinary session, voted 500,000 men and 500,000,000 dollars. By the end of the year 1861, 600,000 men were under arms.

Large armies were formed at first by voluntary enlistment; when a sufficient number of volunteers did not present themselves, each State was required to furnish its quota, the Government giving a bounty. When the quota was not forthcoming, men were drawn by lot.[2]

During the four years' struggle the Northerners had called into the field 2,039,748 men, of whom a million were under arms at the close of the war. They had spent 1,000,000,000*l.* sterling, of which 600,000,000*l.* had been borrowed by the Federal Government. When it is recalled that the debt contracted by Great Britain during the

[1] I say theoretically, because the President, during the Civil War, assumed very arbitrary power.

[2] See Moore's "Putnam's History," vol. viii, p. 459.

old French War from 1793 until its close amounted to 601,500,000*l.*, the enormous rate of expenditure in the American War is realized.[1]

The course of warlike effort which the Northerners found themselves compelled to make is especially noteworthy as showing that countries, the fortunate accident of whose position permits them to dispense with obligatory service in peace time, may, by a profuse expenditure, defer the resort to obligatory service in war for a short time, but if the struggle in which they are engaged becomes protracted are compelled to resort to it. It would appear, too, that the sooner a nation so situated, and which has become involved in a great war, realizes this fact, the better for its Exchequer.

The American Civil War introduced to notice a new instrument of ocean warfare—the steam cruizer, and showed the devastating effect such vessels have upon the mercantile marine of an enemy, even though that enemy be superior at sea. The shipping of the Federals, notwithstanding their superiority at sea, was reduced during the war by 2,000,000 tons owing to the depredations of the Confederate cruizers, and by the panic caused by them, which led to the transfer of shipping from the American to foreign flags, in order to avoid the risk of capture.

The war is also specially noteworthy as illustrating, by the small force of 75,000 men first estimated as necessary to quell the rebellion and the large numbers actually used for the purpose, how enormously a nation may, at the commencement of a struggle, underrate the effort required to bring it to a successful issue; but how rapidly, the magnitude of the effort required once realized, it rises to the occasion.

The population of the Federal States on the outbreak of war was 19,614,885 freemen, 88,986 slaves, that of the Confederates 7,570,224 freemen, 3,860,571 slaves. The efforts made by the Confederates are not here touched upon.

After considering the warlike effort made by the Northern Americans in their civil war, as illustrating what a free country really can do in a national struggle, it is curious to read the idea which obtains of the military effort Great Britain, with a population in the proportion of seven to four to that of the Federal States at the time referred to, might be expected to make if unfortunately she became involved in a great war abroad (no argument is necessary as to the effort which would be made in the event of war within the United Kingdom).

The "Times" of November 25th, 1881, states:—"For a great crisis "like the Russian War or the Indian Mutiny we must possess a large "reserve of trained men, so as to enable us to send into the field at "least two army corps, or an aggregate of little less than 80,000 men," and this statement may be said to take as large a view as has yet appeared in the public press of the force Great Britain would be likely to employ in a great war abroad.[2]

[1] "Statesman's Year Book"; other authorities give direct outlay 630,000,000*l.*, but total cost 831,500,000*l.*

[2] A larger view was taken in 1809, when Mr. Windham stated that England could despatch 100,000 men abroad (Hansard, vol. xii, No. 1111.) Kinglake, vol. vi, p. 461, states that Lord Liverpool, the War Minister, gave the strength of

An article written by Sir Garnet Wolseley in the "Nineteenth "Century," March, 1881, states:—"All serious thinkers upon our "Army requirements, then, at last seemed to agree to the three "following postulates: 1st. That for the protection of these islands "from invasion, for the defence of our foreign possessions, for the "maintenance of our rule in India, and to enable us to fulfil our "Treaty engagements in Europe, we might at any moment find it "necessary to put in the field an army of about 60,000 men, which "should have behind it a thoroughly efficient reserve of well-trained "soldiers of at least equal numbers."

Now it is quite clear from what has been said on the subject of the American War that such a force as is mentioned in the above quotations, and which fairly state the view generally accepted, large as compared with the force sent out by England to the Crimea, by no means represents the fighting power of a country of 35,000,000 of inhabitants, although it may be all that country can employ if it is restricted to certain self-imposed conditions for raising its forces. Nor is the employment of larger forces limited by the inability to transport troops by sea, as is evidenced by the assistance rendered to the French and to the Turks in the transport of their troops in 1855, when British shipping was far less than it now is.

Usually in war the forces a country employs depend upon the forces of an enemy which have to be overcome and upon her own resources.

In a war between European Powers the words of St. Luke, 14 chap., 31 and 32 ver.—"Or what King, going to make war against another "King, sitteth not down first, and consulteth whether he be able with "ten thousand to meet him that cometh against him with twenty "thousand? Or else, while the other is yet a great way off, he "sendeth an ambassage, and desireth conditions of peace"—remain as true as when they were written.

What, then, it may be asked, is the explanation of the idea which obtains in England as to her probable action if involved in a great European war, for it appears to be a conventional idea based on circumstances no longer existing?

An examination of the conditions of war as they affected Great Britain at the time of the Peninsular War appears to furnish the explanation. After the battle of Trafalgar, England had no rival in European waters; she could enter upon a war abroad or withdraw

the Regular Infantry at 210,000, Cavalry 27,000, in that year; the strength of the Artillery and Engineers was not given, but that of the whole land service, exclusive of Sepoys, was stated in Parliament to be 700,000. The forces sent abroad in that year were—

Walcheren	about	40,000
Sicily	„	15,000
Spain and Portugal ..	„	45,000

Kinglake remarks that the numbers of the forces sent abroad cannot be relied on, as it is believed that some of the soldiers were transferred from one theatre of war to another. Still, making every allowance, the force sent abroad must have been more than two army corps.

from it at will, and if she withdrew from it, her enemy's power of injuring her before the days of steam-power at sea was very limited.

The despatches of the Duke of Wellington illustrate very forcibly the secondary light in which foreign war was regarded in England at that time; one political party asserted that it would, if in power, withdraw the Army from Portugal, the other was only prepared to keep it there if the cost could be kept down. The Duke thought that as many troops *as could be spared from other services* should be used in the Peninsula; he went into calculations as to the relative cost of the Army at home and in the Peninsula, and urged the Government to keep the Army in the Peninsula for fear of an attempted invasion of England at a future time, should the French be relieved from the pressure of military operations on the Continent; but it is necessary to quote the despatches, as it is difficult to realize such a situation.

"To the Earl of Liverpool. "Sta. Marinha, 23rd March, 1811.

"My opinion has invariably been, that it was the interest of Great Britain to "employ in Portugal the largest army that could be spared from other services; "and that no more than 2,000 or 2,500 men ought to have been stationed at Cadiz, "which would not have cost a shilling more than their pay. The expense at Cadiz, "which I imagine will amount to no trifle, out of the six or nine millions, has been, "in my opinion, entirely thrown away, equally with the service of the troops, "which would have made a great difference here early in the last summer.

"In respect to offensive or defensive operations here, if they are left to me, I "shall carry on either the one or the other, according to the means in my power, "compared at the time with those of the enemy, and bearing in mind always your "Lordship's instructions of the 27th February, 1810, marked A.

"I would recommend to Government to increase the force here as much as "possible, putting down the establishments elsewhere, and of course decreasing the "expense in those parts of the Empire from which they draw the troops. By this "measure they will put it into the power of the Officer here to avail himself of every "opportunity; they will be sure of holding this country as long as they please; "and they will save the whole expense of transports.

"I shall be sorry if Government should think themselves under the necessity of "withdrawing from this country on account of the expense of the contest. From "what I have seen of the objects of the French Government, and the sacrifices they "make to accomplish them, I have no doubt that if the British Army were for any "reason to withdraw from the Peninsula, and the French Government were relieved "from the pressure of military operations on the Continent, they would incur all "risks to land an army in His Majesty's dominions. Then indeed would commence "an expensive contest; then would His Majesty's subjects discover what are the "miseries of war, of which, by the blessing of God, they have hitherto had no "knowledge; and the cultivation, the beauty, and prosperity of the country, and "the virtue and happiness of its inhabitants, would be destroyed, whatever might "be the result of the military operations. God forbid that I should be a witness, "much less an actor in the scene; and I only hope that the King's Government "will consider well what I have above stated to your Lordship; will ascertain as "nearly as is in their power the actual expense of employing a certain number of "men in this country beyond that of employing them at home or elsewhere; and "will keep up their force here on such a footing as will at all events secure their "possession without keeping the transports, if it does not enable their commander "to take advantage of events, and assume the offensive."

And again he writes—

"Fuente Guinaldo, August 29th.

"We may spend ten millions a year in this country; but it is a very erroneous "notion to suppose that all that expense is incurred by the war in the Peninsula.

"Our establishments which we have here would cost very near half that sum if "they were kept at home, and the surplus only should be charged as the expense of "this war. I do not mean to say that that expense is not great, but it must be "borne as long as the Spaniards and Portuguese can hold out, or we must take our "leave of our character as a great country."

No one can read these despatches without astonishment. I am reminded of an expression used by a French master at a great public school, who complained, when examined before a Commission, of the manner in which the study of foreign languages was slighted in the school course. He said it was treated as an "objet de luxe." Now, if such an expression can be used with reference to so serious a subject as a war, it would appear to apply to the manner in which the British nation treated their war in Portugal at the time these despatches were written.

Imagine Von Moltke, after the Prussian Army was already on foreign soil in one of the recent campaigns, having to plead as a reason why it should not be withdrawn from the theatre of war that its cost was not very much more than if it was at home.

But Great Britain could in those days, as a nation, sit at home at ease and watch the small though heroic military force with which she took part in the Continental struggle, and it may almost be said was able to limit the immediate risk of war to such dimensions as she thought fit.

In the Crimean War, England had the advantage of powerful allies, and was thereby saved from the necessity of employing large forces by land, while Russia had to fight at a point on her territory where it was most difficult for her to muster in strength. Many will recall the expression, "Bleeding the giant in the toe," which was applied to the Sebastopol campaign. Though steam was available at sea, *the power its use conferred on hostile cruizers had not then been illustrated.*

It is contended that the case is very different now. Were England involved in a European war now she would *immediately feel the direct pressure of war by the attacks of hostile steam cruizers* on her mercantile marine, and be obliged to grapple with her antagonist, and to exert her strength.

Great Britain would forthwith be obliged to organize a gigantic system of ocean patrolling to protect her commerce from the attacks of hostile steam cruizers which, however effective, would be enormously expensive. Captain Colomb, in his able lecture on "Naval Intelligence "and Protection of Commerce in War," expresses most clearly the dangers to British shipping, and I shall take the liberty of quoting his words.

He states:—

"Attacks on the high seas will be made by hostile cruizers which "may elude the vigilance of blockading fleets, or by vessels purchased, "fitted out, and armed in rear of our fleets, perhaps thousands of miles "away from the blockaded coasts. It is to be observed that, while "the extent of the enemy's seaboard limits the operations of blockade, "the area of operations for the direct protection of our commerce "has, in a geographical sense, practically no limits at all."

And again—

"It is the very first stage, rather than the closing scenes of mari-
" time war, which decides the fate of such trade. American war
" fleets floated triumphant on the sea long after the American carrying
" trade—terrified by ocean fires kindled by an uncaught 'Alabama'—
" had taken to itself wings and fled. Moral effect is the great force
" to be reckoned with in considering the protection of commerce. If
" the first few weeks of war shakes that ignorance which blindly
" hopes that our naval arrangements for war are commensurate with
" our commercial necessities, the British mercantile marine will pro-
" bably disappear in a reaction of panic."

The great value of the carrying trade of Great Britain has been generally recognized in the discussion which has lately appeared in the press upon imports and exports. Captain Colomb estimates the value of British trade at sea requiring protection in war at 800,000,000*l.* a year, and for its protection he considers that six squadrons are required in the Atlantic Ocean alone.

Whatever system, however, were to be adopted for the protection of the mercantile marine, it is abundantly clear that the cost to the Government would be very great, and the cost to shipowners for the arming of their vessels, and probably all vessels would have to be armed in some way, as well as for the payment of the high rates of insurance, would also be very great.

It is also clear that other Powers are fully alive to the effective use which can be made of the new weapon in naval warfare—the steam cruizer—as is evidenced by the formation of their volunteer fleet by the Russians when there was a probability of war between Russia and this country.

Since this lecture was written Sir William Armstrong has given an address upon the national defences, in which he expatiates upon the effect of steam cruizers in future wars; he spoke as follows:—

" Light unarmoured ships, designed by Mr. George Rendel, had
" lately been built in this country for foreign Powers, which, with a
" displacement of only 1,300 tons, had attained a speed of 16 knots an
" hour. They carried coal for steaming 4,000 miles, and had already
" actually steamed 3,500 miles without replenishing. They were each
" armed with two 10-inch new type guns, which had nearly an
" all-round fire, and were capable of piercing 18 inches of iron
" armour, and with four 40-pounders on the broadsides. It was a
" very serious question what could be done in the event of a number
" of such vessels as these being let loose upon our commerce. At
" present there was not a single ship in the British Navy carrying an
" armament competent to engage them, that could overtake them in
" pursuit, or evade their attack when prudence dictated a retreat.
" Confidence was often expressed in our mercantile marine being
" capable of furnishing, on an emergency, a supply of vessels fit to be
" converted into cruizers; but where were there to be found among
" trading or passengers steamers vessels possessing a speed of 16 knots,
" with engines and boilers below water-level, and having an under-

" water deck to save them from sinking when penetrated by projectiles " at or below the water-line ?"

It is submitted, therefore, that the days for England to carry on a great war with a small military force are past; that the idea of doing so is a dangerous delusion calculated to encourage the country to enter upon such a war with a light heart, but without having determined upon the vigorous action which will be necessary.

If England does become involved in such a war, she will have to do her utmost both by land and sea to bring it to a speedy and successful conclusion. If this view is correct, it is unlikely that England could confine herself to the holding of a small peninsula or marine fortress even in a war in which her interests were *secondary*, but would be constrained to grapple with her adversary.

There is, however, one question outside the United Kingdom in which the interests of England are of *primary* importance. The maintenance of her communications with India would always be a matter of vital importance to England, in defence of which she would feel obliged to exert all her force. Differences of opinion there doubtless would be as to the circumstances which were to be regarded as menacing the way to India, but for the maintenance of the way to India, whatever it might at the time be considered to be, Great Britain with or without an ally would be obliged to contend in earnest.

In such a war it would be quite impossible to limit the forces employed to two army corps. *The force necessary for the service to be performed would have to be used.* There would, doubtless, as there was in America, be a period of hesitation, but, as there, a revulsion of feeling would take place, the country would see the absolute necessity for carrying on the war in an effective manner, and would adopt whatever measures were necessary to raise the force required.

It may be well to recall what occurred in 1878, when it was thought necessary to oppose the occupation of Constantinople by the Russians, as illustrating the impossibility of attempting to limit the force to be employed to two army corps.

The Turkish forces, repulsed at all points, were retiring on the Gallipoli and Constantinople peninsulas. The great importance of holding these peninsulas was indisputable.

Supposing two army corps had been sent out from this country in time to take part in the defence of those peninsulas. Let us suppose that the regular regiments left at home were being raised as quickly as possible to a war strength, and that a reserve corps of some regiments in process of augmentation was concentrated, and the militia called out, the strength of the Reserve Forces, militia and volunteers, classed as efficient, would have amounted to 300,000. Behind the volunteers, ex-volunteers to a number equal to those serving might probably fairly be counted upon as available on an emergency. Danger of an invasion there was none.

Is it conceivable that with this large defensive force at home, that no matter what the necessity for troops at the front, that no more force would have been sent out from England, but that all the regular

regiments when completed would have gone on quietly doing goose-step at home?

It is contended, on the contrary, that besides officering and organizing regiments of Turks a third army corps would have been sent out, no matter how composed, as soon as vessels could be got ready, as the reserve division was sent out in the Crimean War; that the services of militia regiments volunteering would have been accepted either directly for the war or to release regular regiments, and that provisional volunteer battalions would have been enlisted for the war on special conditions as rapidly as possible.

It is contended, then, that though a well-grounded hope may be entertained that Great Britain will not become involved in a war with a Great Power, it is unreasonable any longer to assume that, if she does become involved in such a war, hostilities can, under any circumstances, be carried on with small means.

Fortunately, in the interests of peace, no foreign nation is likely to believe in the professed inability of Great Britain to put a larger force than two army corps into the field.

If it were stated that owing to a difficulty in getting men to train at Oxford the boat-race this year would still take place, but that that University would compete in a pair-oar, every expert would know that the idea was Quixotic. If a great athlete announced his intention of competing in a foot-race, but stated that he intended to confine himself to hopping; or in a wrestling match, but to confine himself to the use of one arm, his opponents would smile, but would not relax their training preparations.

A medical man sometimes is called in to see a full-fed patient, who says he is unequal to the slightest exertion, the least thing fatigues him, but after examining him his physician is able to say with confidence, "What you are suffering from is 'languor,' not 'weakness'; " if your house were to catch fire you would soon find the full use of " your limbs."

So with England, a statesman of the calibre which it is the fashion here to impute to Continental statesmen would not be misled as to the forces which England said she intended to use. He would consider what such a nation really could do, and assume that, the necessity arising, what the country could do, it would do.

What steps, then, it may be asked, can Great Britain take in peace-time to provide for the contingency of a great war? The Army and militia reserves as at present organized can only be counted upon to complete corps to their war establishment, not to replace casualties for any length of time.[1]

Her large *latent* military force, like that of America, can only be gradually developed, and the only way in which preparation for its development can be made in peace-time is by the formation of a *clear*

[1] See Appendix.

If two army corps were sent out *now*, the country would practically be face to face with the question of manning the Army *immediately*; if an *Army* were sent out at any time, even if the reserve had reached its full ideal strength of 60,000 men, the country would equally be face to face with this question.

plan as to the manner in which that development can best be effected; for the Government is powerless to take any active measures in such a matter until public opinion is ripe for such action.

Probably the experience of America would be found the best guide. As applied to England it appears to be—

First. To form provisional battalions in regimental districts of men enlisted for the war on special conditions.

To give a special rate of deferred pay to men actually in the field, such pay to go to their next of kin if they fell.

Secondly. To require regimental districts to furnish a quota for their regiments or for general service, giving bounties and allowing substitutes,[1] but requiring the individual to find his own substitute, and be personally responsible for him in case of desertion; the man so drafted might also be required to serve as an efficient volunteer himself; the regimental districts would doubtless add to the bounties; *the voluntary system would thus be used as long as possible.*

Finally. If necessary, obligatory service, forbidding substitutes, would have to be resorted to.

The small *active* force of Great Britain should, it is submitted, have the establishment of all corps fixed at a strength which would admit of their being able to take the field at once in an efficient state on receiving a quota from the reserve. At present this is far from being the case: in the infantry 43 battalions are at a peace establishment of 480 rank and file, and 6 battalions at an establishment of 500; if these battalions were suddenly raised to the war-strength of 1,000 rank and file, nearly two-thirds of the men composing them would be strangers; the battalions could not assimilate so large a contingent of strangers, and yet be regarded as fairly representative of their regiments.[2]

It is urged that if the strength of the weak battalions cannot be increased without reducing the strength of the battalions first for service, it would be better even to do that, and, unless reservists can be employed in them, to reduce the war-strength of battalions for little wars. Were the number of battalions required to take part in a little war consequently increased, it would be preferable to continuing to keep a large proportion of the regiments at establishments from which they cannot, on receiving a quota of reservists, at once be expanded to a war-strength, and regarded as efficient for immediate service.

Then as to the reserve: the value to a nation of a reserve of trained soldiers, who can be recalled to the ranks on the outbreak of war, and enable that nation to take the field with a much larger force than it could otherwise do, is unquestionable, and a local connection is a proper complement of any system of expansion, as it supplies a bond of union which otherwise can only be obtained by long association, but it is urged that the conditions of reserve service in this country are very disadvantageous to the State. The soldier of the reserve is not liable

[1] See Appendix C.

[2] It is assumed that these regiments, like those sent to Zululand in 1879, would leave one-fourth of their strength behind them, and of their strength going out, 360 rank and file would be their own men, and 640 rank and file would be strangers.

to be called out for a little war, consequently, when such a war occurs, the regiments to be sent out have either to be completed to a war establishment, by robbing other battalions at home of men they can ill spare, as hitherto, or must be kept up to a high establishment, as now intended, at the expense of the battalions last for service, and even so the small battalions will have to supply men to replace those medically unfit as well as for special corps. In either case the regiments sent out are deprived of the steadying effect of the older soldiers from the reserve.

One of the most serious inconveniences of the system of small establishments, for which, so far as I know, no remedy has been proposed, is that special corps in the British Army are not self-supporting. On the outbreak of a little war men are required for the Army Hospital Corps, Army Service Corps, and any other corps which may be formed, but as the men in the reserve cannot be called upon, the only source from which to draw them is the attenuated infantry regiments at home, which probably have a very large proportion of young soldiers. Imagine an Officer commanding a regiment with more than 40 per cent. of his men under one year's service—and I do not state an imaginary percentage—in addition to the usual requisitions for drill instructors and cooks for militia, &c., being called upon to furnish volunteers of good or fair character, and some service, to each of such special corps, and to send steady men to do the duty of Army Hospital men gone on service, afterwards receiving an order to forward the names of fifteen men of fair character, two years' service, and unmarried, who are willing to volunteer to such and such a regiment. He may also, with what, considering his field of choice, must appear to him a delicate irony, be informed that considerable inconvenience had been experienced in consequence of men of indifferent character having been recommended for transfer, and that care must be exercised in the selection of men of really fair character from those volunteering.[1]

By a process of this sort, not only is a small battalion rendered unfit to go on service itself, were an emergency to arise, but even ceases to be as efficient as it ought to be as a training school for recruits.

The reserve man now gets 6*d.* a day, and is not liable to be called out for little wars, even if sent to the reserve prematurely at his own request: and assuming the reserve to be called out once in a generation—thirty years—the retaining fee paid for a reserve man by the State amounts to 43*l.*, without reckoning the loss sustained by the State on men who do not appear, or the cost of Staff.[2]

The chances of a reserve man not being called out at all are as five to one, so that really, when one thinks of the strain of a little war upon the Army while the reserve man is looking on, his post seems to be very much the sort of post the late Sam Weller, junior, prized,—"not "much to do and a good deal to get." We temper the blade at great

[1] The French have felt the evil effects of transferring men from corps to corps in their Tunis Campaign.

[2] See Appendix D.

trouble and expense, and then put it on the shelf to rust, and use the half-tempered.[1]

It ought to be very clearly stated that the conditions of reserve service have been enormously altered in favour of the soldier since the institution of the force; not only does the man in the reserve get 6*d.* a day instead of 4*d.*, without any further obligation, but on entering the reserve he is presented with his accumulated deferred pay with which he can purchase his discharge, *so that no man need remain in the reserve who does not wish to do so.*

One can understand that it is desirable in order to encourage entrance into the Army to make the exit as easy as possible, but as deferred pay enables any man who wishes it to take his discharge from the Service *altogether*, it is contended that if more were now asked from a reserve man it ought not prejudicially to affect recruiting.

It is urged, then, that men of the Army Reserve should be liable to serve in any little wars in which their regiments have a battalion engaged, and that to provide for the loss sustained by the reserve arising from discharges from that force by purchase, there should be *direct* enlistment permitted into the reserve force to men who have served not less than two or three years in the Army, and have been discharged with a fair character, and that men so enlisting should be liable to *general* service in little wars; probably many men after purchasing their discharge from the reserve would also again enlist in it, were direct enlistment into it permitted. Ex-militia reserve men and ex-volunteers of certain qualifications might with advantage possibly be permitted to enlist into the Army Reserve, and there might be two rates of pay, 4*d.* if liable to serve only when there is an emergency, and 6*d.* if liable to serve any time when a little war occurred or was probable.

When one considers how inevitably the establishments of corps are affected by considerations of cost, it may not be out of place to remark that the wealth of the country has quadrupled since 1815, and the population has nearly doubled, and that it behoves the Services always to urge that any comparison instituted between the cost of forces at two periods should have regard to the population and wealth of the country at each period.

In order that every Officer should feel the importance of effecting economies in matters not affecting efficiency in order to obtain as many men as possible for the Army, it is urged that every Officer commanding a corps should report, for the information of the General Officer commanding the district, upon any economies he thinks desirable, but that the General Officer should only forward any suggestion in which he concurs.[2]

[1] There seems no valid reason why a reserve man, who may be regarded as a man on continuous furlough, should not have the right to serve on for pension if recalled to the colours.

[2] The system of public accounts, requiring all money voted in any one year to be spent in that year, militates against economy in engineers' work. There is a natural anxiety to spend all money voted instead of swelling the Estimates of

The three points I wish specially to urge, then, are—

1st. That there should be a definite plan thought out how best to develop the *latent* force of the country.

2nd. That all the corps of the active Army should be kept at such establishments as admit of their immediate expansion to the war-strength, after receiving their quota of reservists, as efficient fighting bodies.

3rd. That reservists should be held liable to serve in any little wars in which their regiments may be engaged, and that men who have served a certain period in the Army, and have been discharged with a fair character, should be enlisted direct into the reserve for general service in it.

I must ask your indulgence for treating a large subject in so cursory a manner, my object being to draw attention to what appear to me grave though remediable defects in our system, viz., the smallness of the establishment of a large number of battalions and the conditions of reserve service, and to elicit opinions from others better informed on the subject than I am.

I have purposely avoided touching upon the special requirements of the special arms, though I believe the numbers are found scanty in some mounted branches; upon the assistance which Great Britain might receive from her external Empire, assistance difficult to measure but always increasing; and I have assumed superiority at sea in the supposed contingency so as to limit my subject.

I have also avoided all allusion to the present state of Ireland, as hitherto, in presence of an external foe, Ireland has been loyal, and bad as the state of things there is now, we may hope that it is temporary.

another year, hence, savings on services that with time might be profitably spent, are liable to be expended too hastily, and for building purposes at the very worst time of the year.

Possibly some change in this system, as in that of small transfers requiring Treasury authority, might be effected without the sacrifice of a thorough Parliamentary control.

APPENDIX A.

(*Extract from Army Reorganization Committee's Report*, 471.)

1st Army Corps.

STATEMENT showing the establishment of an army corps for service in the field, the strength of the 1st Army Corps (deducting non-effectives) according to the latest returns, the number required to complete to the War Establishment, and the measures proposed to supply the deficiency—distinguishing the several branches of the Service, and the number of Officers, non-commissioned officers, and men, Officers' horses, riding and draught horses, field guns, and carriages.

Horse Guards, War Office, 1st July, 1879.

RECAPITULATION.

	Officers.	Non-commissioned officers and men.	Officers' horses (private)	Public horses.	Field guns.	Carriages.
Establishment of an Army Corps for field service	1,414	35,599	1,213	11,384	90	1,631
	37,013		12,597			
Strength of the 1st Army Corps (deducting non-effectives)	936	19,916	546	4,243	90	244
	20,852		4,789			
Required to complete to war establishment	478	15,683	667	7,141	...	1,387
	16,161		7,808			
HOW TO BE SUPPLIED.						
Officers and Officers' chargers — Regimental	267	...	339			
Officers and Officers' chargers — Staff and departmental	211	...	328			
By transfer from other corps	...	3,130	...	2,378		
[1]From Army Reserve — For regiments	...	6,919				
[1]From Army Reserve — Cavalry and infantry drivers	...	594				
[1]From Militia Reserve — Combatants	...	2,683				
[1]From Militia Reserve — Bâtmen	...	606				
[1]From Militia Reserve — Drivers, &c., for Army Service Corps	...	1,153				
[1]From Militia Reserve — Bearers for Army Hospital Corps	...	380				
To be enlisted (drivers and Royal Engineer Train)	...	169				
From General Post Office	...	49				
To be purchased	...	...	...	4,763		
To be supplied from store or requisitioned	...	...	...	...	...	1,387
General total	478	15,683	667	7,141	...	1,387
	16,161		7,808			

[1] N.B.—After completing the 1st Army Corps there will remain available 8,637 1st Class Army Reserve, 20,562 Militia Reserve.

C. H. ELLICE, *Adjutant-General.*

2nd Army Corps.

STATEMENT showing the establishment of an army corps for service in the field, the strength of the 2nd Army Corps (deducting non-effectives) according to the latest returns, the number required to complete to the War Establishment, and the measures proposed to supply the deficiency—distinguishing the several branches of the Service, and the number of Officers, non-commissioned officers, and men, Officers' horses, riding and draught horses, field guns, and carriages.

Horse Guards, War Office, 1st August, 1879.

RECAPITULATION.

	Officers.	Non-commissioned officers and men.	Officers' horses (private)	Public horses.	Field guns.	Carriages.
Establishment of an Army Corps for field service	1,414	35,599	1,213	11,384	90	1,631
	37,013		12,597			
Strength of the 2nd Army Corps (deducting non-effectives)	841	15,988	510	3,645	90	173
	16,829		4,155			
Required to complete to war establishment	573	19,611	703	7,739	...	1,458
	20,184		8,442			
HOW TO BE SUPPLIED.						
Officers and Officers' chargers — Regimental	317	...	337			
Officers and Officers' chargers — Staff and departmental	256	...	366			
By transfer from other corps	...	2,325	...	596		
[1]From Army Reserve — For regiments	...	7,812				
[1]From Army Reserve — Infantry drivers	...	462				
[2]From Militia Reserve — Combatants	...	6,145				
[2]From Militia Reserve — Bâtmen	...	606				
[2]From Militia Reserve — Drivers, &c., for Army Service Corps and Cavalry	...	1,307				
[2]From Militia Reserve — Bearers for Army Hospital Corps	...	380				
From General Post Office	...	49				
To be enlisted (drivers and Royal Engineer Train)	...	525				
To be purchased	...	...	...	7,143		
To be supplied from store or requisitioned	...	...	...	...	...	1,458
General total	573	19,611	703	7,739	...	1,458
	20,184		8,442			

[1] N.B.—After completing 1st and 2nd Army Corps there will remain 363 1st Class Army Reserve, 12,064 Militia Reserve.

C. H. ELLICE, *Adjutant-General.*

Deductions from the strength of the 1st Army Corps, as estimated in this lecture :—

For men found unfit though serving	4 per cent.	10 per cent.[1]
Recruits and other casualties	6 per cent.	
Absentees of Army and Militia Reserves	5 per cent.	10 per cent.
Men *found unfit* „ „	5 per cent.	

Men serving, 19,916, at 10 per cent.	1,990
Reserves 12,335, „	1,233
	3,223

Similar deductions from 2nd Army Corps :—

Men serving, 15,988, at 10 per cent.	1,598
Reserves 16,712, „	1,671
	3,269

Reserves remaining *after two army corps formed* :—

Army Reserve	363	
Militia „	12,064	
	12,427	
Deduct 10 per cent.	1,242	
	11,185	
Deduct men required to replace absentees, &c., men medically unfit, &c.	6,492	
	4,693	Remain available as First Reinforcement at the date of return.

Now, in 1882, the Army Reserve is said to be 28,000 as against 15,787, the number of that force included in the return. The increase, then, is 12,213 less 10 per cent. = 10,992 men.

Add increase to Army, 1881	1,351	
Add Reserves available as First Reinforcement at date of return	4,693	
	17,036	
Deduct Transfers no longer required	5,455	
	11,581	available *now* as First Reinforcement.

At the Crimean rate of waste, 6 per cent. per mensem, 4,308 men, this reinforcement would last between *two and three months.*

[1] A deduction of only 10 per cent. assumes the regiments first for service in a very satisfactory state; if 25 per cent. had to be deducted, as in the case of regiments sent to Zululand in 1879, there would have been but 404 men available for reinforcement.

Let us suppose, however, that the Army Reserve was actually....	60,000
then deducting the number	15,787
already accounted for in the return, there remains	44,213
or, deducting 10 per cent.	39,792
Add increase to Army, 1881	1,351
Add First Reinforcement in return	4,693
Available as reinforcements if two army corps sent out and a reserve of 60,000	45,836
Deduct transfers	5,455
Available as reinforcements	40,381

Two army corps $35,599 \times 2 = 71,798$ non-commissioned officers and men.

Supposing the waste of the two army corps to be at the Crimean rate, given in the report of Lord Airey's Committee as 78 per cent., or 6 per cent. per mensem = 4,308 men per mensem, these reinforcements would last *nine months.*

If, however, 44,025 men is to be considered as the maximum number to which the reserve can attain

	44,025	
Deduct	15,787	already accounted for in return.
	28,238	
Deduct 10 per cent.	2,823	
	25,415	
Add	1,351	increase to Army, 1881.
	4,693	remaining for First Reinforcement at the time of the return.
Available as reinforcements	31,489	
[1] Less transfers not required	5,455	
	25,825	

At the rate of waste above calculated they would feed the two army corps for nearly *six months.*

[1] These transfers are disastrous to the Army, they would leave the regiments at home in a very inefficient state.

APPENDIX B.

RETURN showing the Increase and Decrease of the several Battalions of the Foot Guards and Infantry of the Line which proceeded from Varna to the Crimea in August, 1854, between 1st September, 1854, and 1st October, 1855.

Horse Guards, War Office, 24th July, 1879.

Regiment.	Strength on 1st Sept. 1854.			Increase.				Decrease.						Strength on 1st October, 1855.			
														In Crimea.			
	Approx. Nos. disembarked in Crimea.	Absent.	Total.	From Desertion.	From Depôts.	Other causes.	Total.	Dead.	Discharged.	Deserted.	To Depôts.	Other causes.	Total.	Fit for Duty.	Sick.	Absent.	Total.
Grenadier Guards, 3 Bt.	870	181	1,051	2	932	17	951	723	1	2	359	4	1,089	732	138	43	913
Coldstream Guards, 1 Bt.	840	156	996	1	523	...	524	635	...	...	205	2	842	555	102	21	678
Scots Fusilier Gds., 1 Bat.	837	192	1,029	...	573	6	579	552	...	5	263	5	825	637	99	47	783
1 Foot, 1 Battalion	747	136	883	...	695	1	606	418	...	3	134	10	565	740	48	136	924
4 ,, ...	610	262	872	...	552	3	555	274	...	2	230	5	511	748	52	116	916
7 ,, ...	833	135	968	3	713	1	717	467	...	10	270	32	779	589	89	228	906
19 ,, ...	908	84	992	...	366	7	373	404	...	4	221	3	632	476	132	125	733
20 ,, ...	948	11	959	...	231	2	233	369	2	12	175	2	560	526	26	80	632
21 ,, ...	978	...	978	1	412	13	426	364	...	1	202	46	613	689	41	61	791
23 ,, ...	900	66	966	...	810	6	816	554	1	1	295	26	877	569	145	191	905
28 ,, ...	640	214	854	2	630	2	634	359	...	8	184	4	555	753	63	117	933
30 ,, ...	750	131	881	1	367	4	372	377	1	4	228	10	620	410	80	143	633
33 ,, ...	794	175	969	4	475	...	479	448	...	6	328	21	803	463	47	135	645
38 ,, ...	829	23	852	3	688	3	694	405	...	8	227	3	643	796	47	60	903
41 ,, ...	840	107	947	...	451	10	461	386	...	4	227	6	623	543	141	101	785
42 ,, ...	869	77	946	1	216	12	229	235	...	1	77	16	329	761	59	26	846
44 ,, ...	719	184	903	...	511	4	515	421	...	...	204	16	641	613	77	87	777
47 ,, ...	777	161	938	2	378	4	384	332	...	8	207	6	553	629	40	100	769
49 ,, ...	734	157	891	...	456	3	459	346	3	7	191	7	554	591	92	113	796
50 ,, ...	763	95	858	...	346	4	352	449	...	3	143	28	623	509	37	41	587
55 ,, ...	743	143	886	...	499	...	499	338	...	...	237	16	591	586	73	135	794
63 ,, ...	949	22	971	...	338	1	339	446	1	1	147	13	608	533	52	117	702
68 ,, ...	816	45	861	2	372	12	386	249	15	2	131	40	437	673	32	105	810
77 ,, ...	807	169	976	3	658	5	666	422	1	1	221	23	668	732	52	190	974
79 ,, ...	860	96	956	3	279	9	282	334	3	9	122	11	470	663	27	69	759
88 ,, ...	787	175	972	4	686	7	697	452	...	2	266	21	741	598	141	179	918
93 ,, ...	872	100	972	4	239	6	249	265	...	1	177	14	457	642	60	62	764
95 ,, ...	847	132	979	1	385	3	389	501	...	6	257	1	765	436	40	127	603
Rifle Brigade, 1 Battalion	887	62	949	...	597	5	602	422	...	...	235	5	662	621	87	181	889
Rifle Brigade, 2 Battalion	952	127	1,079	1	572	1	574	369	...	...	245	7	621	725	59	248	1,032
Total ...	24,706	3,618	28,324	40	14,851	151	15,042	12,316	28	111	6,408	403	19,266	18,538	2,178	3,394	24,100
														20,716			

The approximate strength of the infantry which disembarked in the Crimea prior to the Battle of the Alma was 24,706; the loss to the 30 battalions composing this force to the 1st October, 1855, was by deaths 12,316; sent to depôts at home 6,408; and by other causes 351, making a total of 19,075; this loss on the original strength is equal to 78 per cent., or 6 per cent. per mensem.

Drafts to the amount of 14,851 men joined these battalions.

(Signed) C. H. ELLICE, *Adjutant-General.*

RETURN to an Address of the Honourable the House of Commons, dated 18th February, 1879, for a Return of the non-commissioned officers and privates of the 2/21st, 58th, 3/60th, 91st, and 94th, as they embark for active service for the Cape of Good Hope, showing ages, length of service, and number who have not completed their drill and musketry instruction; also number drawn to complete for service from other regiments, in a classified tabular form.

FRED. STANLEY.

War Office, 29th April, 1879.

21ST FOOT, 2ND BATTALION.

Ages on Embarkation.	Non-commissioned Officers.	Privates.	Total.	Services on Embarkation.	Non-commissioned Officers.	Privates.	Total.
20 years and upwards	63	251	314	6 years and upwards	63	131	194
22 ,, under 24 years	9	145	154	5 ,, under 6 years	...	23	23
21 ,, ,, 22 ,,	11	183	194	4 ,, ,, 5 years	7	23	30
20 ,, ,, 21 ,,	5	102	107	3 ,, ,, 4 ,,	6	26	32
19 ,, ,, 20 ,,	2	68	70	2 ,, ,, 3 ,,	4	60	64
18 ,, ,, 19 ,,	...	45	45	18 months and under 2 years	3	95	98
Under 18 years	...	4	4	15 ,, ,, 18 months	4	70	74
				12 ,, ,, 15 ,,	1	67	68
				Under 12 months	2	303	305
Total	90	798	888	Total	90	798	888

Numbers embarked not having completed drill and rifle instruction			None reported.	
Numbers taken from other regiments to complete			...	282	282
Numbers left at home for physical causes, youth, &c.	Medically unfit		9	43	52
	Not exercised in musketry		...	248	248
	Awaiting discharge		1	4	5
	Boys under age		...	15	15
	In prison		...	21	21
	On furlough, did not receive notice to rejoin		...	5	5
	Absent without leave		...	9	9
		Total	10	345	355

58TH REGIMENT.

Ages on Embarkation.	Non-commmissioned Officers.	Privates.	Total.	Services on Embarkation.	Non-commissioned Officers.	Privates.	Total.
24 years and upwards	59	349	408	6 years and upwards	49	272	321
22 ,, under 24 years	9	77	86	5 ,, under 6 years	11	21	32
21 ,, ,, 22 ,,	10	111	121	4 ,, ,, 5 ,,	5	17	22
20 ,, ,, 21 ,,	13	150	163	3 ,, ,, 4 ,,	4	53	57
19 ,, ,, 20 ,,	...	82	82	2 ,, ,, 3 ,,	7	160	167
18 ,, ,, 19 ,,	...	22	22	18 months and under 2 years	4	128	132
Under 18 years	...	2	2	15 ,, ,, 18 months	1	29	30
				12 ,, ,, 15 ,,	6	73	79
				Under 12 months	4	40	44
Total.....	91	793	884	Total.....	91	793	884

Numbers embarked not having completed drill and rifle instruction	...	5[1]	5
Numbers taken from other regiments to complete	...	197	197
Numbers left at home for physical causes, youth, &c. — Medically unfit	7	48	55
Not exercised in musketry	...	86	86
Awaiting discharge	2	5	7
Boys under age		22	22
In prison	...	15	15
Absent without leave	1	2	3
Left for duty and on command	2	3	5
Total.....	12	181	193

[1] Three had completed instruction in individual firing, one had served previously in American War, one was enlisted by special authority.

E

60TH FOOT, 3RD BATTALION.

Ages on Embarkation.	Non-commissioned Officers.	Privates.	Total.
24 years and upwards	56	228	284
22 ,, under 24 years	5	87	92
21 ,, ,, 22 ,,	13	134	147
20 ,, ,, 21 ,,	15	199	214
19 ,, ,, 20 ,,	...	75	75
18 ,, ,, 19 ,,	...	60	60
Under 18 years	...	17	17
Total.....	89	800	889

Services on Embarkation.	Non-commissioned Officers.	Privates.	Total.
6 years and upwards	51	204	255
5 ,, under 6 years	2	79	81
4 ,, ,, 5 ,,	9	57	66
3 ,, ,, 4 ,,	8	61	69
2 ,, ,, 3 ,,	9	181	190
18 months and under 2 years	5	102	107
15 ,, ,, 18 months	5	26	31
12 ,, ,, 15 ,,	...	15	15
Under 12 months	...	75	75
Total.....	89	800	889

	Non-commissioned Officers.	Privates.	Total.
Numbers who embarked not having completed drill and rifle instruction	...	43	43[1]
Numbers taken from other regiments to complete	...		
Numbers taken from 1st battalion of same regiment	1	214	215
Numbers left at home for physical causes, youth, &c.: Medically unfit	3	18	21
Not exercised in musketry	...	91	91
Awaiting discharge	...	6	6
Boys under age	...	4	4
In prison	...	6	6
At Kneller Hall	1	1	2
Absent without leave	...	1	1
Total.....	4	127	131

[1] Authorised at special request of Commanding Officer.

91st Regiment.

Ages on Embarkation.	Non-commissioned Officers.	Privates.	Total.	Services on Embarkation.	Non-commissioned Officers.	Privates.	Total.
24 years and upwards	36	223	259	6 years and upwards	32	117	149
22 ,, under 24 years	18	139	157	5 ,, under 6 years	4	9	13
21 ,, ,, 22 ,,	7	97	104	4 ,, ,, 5 ,,	15	41	56
20 ,, ,, 21 ,,	5	150	155	3 ,, ,, 4 ,,	4	22	26
19 ,, ,, 20 ,,	4	141	145	2 ,, ,, 3 ,,	5	85	90
18 ,, ,, 19 ,,	1	58	59	18 months and under 2 years	1	81	82
Under 18 years of age	...	14	14	15 ,, ,, 18 months	10	101	111
				12 ,, ,, 15 ,,	...	106	106
				Under 12 months	...	260	260
Total	71	822	893	Total	71	822	893

Numbers who embarked not having completed drill and rifle instruction		None reported.		
Numbers taken from other regiments to complete		...	374	374
Numbers left at home for physical causes, youth, &c.	Medically unfit	8	34	42
	Not exercised in musketry	...	108	108
	Awaiting discharge and transfer	6	6	12
	Boys under age	...	6	6
	In prison	...	4	4
	At Kneller Hall and the Curragh	1	3	4
	Absent	...	3	3
	Total	15	164	179

94th Regiment.

Ages on Embarkation.	Non-commissioned Officers.	Privates.	Total.	Services on Embarkation.	Non-commissioned Officers.	Privates.	Total.
24 years and upwards	61	200	261	6 years and upwards	51	110	161
22 ,, under 24 years	5	142	147	5 ,, under 6 years	...	21	21
21 ,, ,, 22 ,,	5	117	122	4 ,, ,, 5 ,,	5	41	46
20 ,, ,, 21 ,,	4	154	158	3 ,, ,, 4 ,,	7	65	72
19 ,, ,, 20 ,,	3	125	128	2 ,, ,, 3 ,,	3	81	84
18 ,, ,, 19 ,,	2	63	65	18 months and under 2 years	10	136	146
Under 18 years of age	...	...	...	15 ,, ,, 18 months	2	76	78
				12 ,, ,, 15 months	2	50	52
				Under 12 months	...	221	221
Total	80	801	881	Total	80	801	881

Numbers who embarked, not having completed drill and rifle instruction	None reported.		
Numbers taken from other regiments to complete	...	346	346
Numbers left at home for physical causes, youth, &c.: Medically unfit	...	35	35
Not exercised in musketry	...	90	90
Awaiting discharge	3	9	12
Boys under age	...	12	12
In prison	...	32	32
At Kneller Hall	...	2	2
Absent	...	4	4
Total	3	184	187

War Office, 29th April, 1879.

R. B. HAWLEY, *Deputy Adjutant-General.*

Appendix C.

On the flow of recruits being insufficient, bounties would have to be given, when a large part should be deferred.

The limit to which bounties should be given before resorting to obligatory service is all-important to determine; if too high they might demoralize the Army.

General Sherman, in his "Memoirs," page 387, advocates high pay in preference to exaggerated bounties. He also says the United States tried almost every system known to modern nations, all with more or less success, voluntary enlistments, the draft, and bought substitutes, and that all Officers of experience will confirm his assertion that the men who voluntarily enlisted at the outbreak of the war were the best, better than the conscript, and far better than the bought substitute.

Appendix D.

A Prussian battalion on a peace establishment is not called upon to feed other corps, and on its expansion is fed by reservists from its own neighbourhood, who have probably served in its ranks; the population in England is more urban and more migratory, and though some regiments can draw their recruits from their own sub-district others cannot. The rate of wages varies so much that though everything is wisely done to encourage the completion of regiments from their own sub-district, the result cannot be counted on, nor can it be guaranteed that a man will reside after his service where he resided before it. Besides, the men in a Prussian regiment are of all grades and all degrees of education, therefore, a monitorial influence pervades the mass; in an English regiment, on the contrary, the men are almost exclusively drawn from the wage-receiving class; therefore, the two cases are not absolutely identical, and it may be that while expansion is good for both services, it ought not to be pushed to the same extent in the British Service as it is in the Prussian.

General Higginson, C.B.: My old association with Colonel Blundell, as he lately belonged to the Staff of the district which I have the honour to command, tempts me to allude to one point in his lecture which he and I have frequently discussed, and which I think ought to interest everyone who considers military subjects, whether he be civilian or soldier. I allude to the deferred pay, which is now supposed to be so strong a temptation to recruits to enlist. My experience leads me to doubt whether deferred pay has produced the advantages which the country was led to expect. There is one point so dangerous in it that I have some hesitation in alluding to it; at the same time I think that we ought not to separate without being aware that one who has a right to know, is prepared to assert that the deferred pay of soldiers is what is vulgarly called "discounted" previous to their discharge. That alone is a very serious element of danger. The men borrow money, in short, upon a reversion which is practically inalienable, that is to say, nothing but conviction for felony or desertion can prevent the soldier who has earned his deferred pay from obtaining it on his discharge. It is not, therefore, very difficult, if a man desires to get away from his regiment previous to his proper term of service, for him to obtain through a money lender sufficient money to purchase his freedom. The same uncertainty and, therefore, danger, partially applies to his service in the reserve; and when I tell you that within the last week, two of these reserve men have applied to me, as commanding a district, one saying that he was in a state of starvation, and would give anything in the world to be allowed to re-enlist, because he could not obtain employment, being known to be a reserve man; and another writes, "May I emigrate, because three situations which I have tried for I have

"been refused because I am a reserve man?" you will, I think, consider that the reserve principle is not working so healthily as many of us have been led to suppose. In saying this, God forbid that I should say anything against the principle of the reserve, but I think it should be well considered whether the enormous amount of money paid to soldiers entering the reserve as deferred pay, produces all the advantages that we are led to expect.

The CHAIRMAN: As no one else rises I must say a few words, though I am not inclined to differ from Colonel Blundell in any way. He has rather understated the difficulties that would occur in sending two army corps abroad. In 1877 and 1878 the reserve was less numerous and the difficulties greater. Though there are many who disapprove of the short service system, that system has enabled us to do more than we could ever have done with long service. We could now, with the aid of the reserve, without great difficulty, send two corps d'armées abroad and leave about 7,000 of the first reserve at home. After sending eight battalions to the Mediterranean to relieve the eight battalions taken for the first corps, there would remain at home thirty-one battalions of weak strength, which would be filled up by the militia reserve, leaving the 7,000 of the first reserve to fill up the casualties which would be caused, as Colonel Blundell truly says, very quickly on service. When the Crimean War commenced we could not have sent one corps d'armée. In those days of boasted long service what was the case? To despatch the small force first embarked it was necessary to draw men from other regiments. Volunteers were called for in order to bring the regiments up to war strength. The 93rd, for instance, were called upon to volunteer for the 42nd, and the 93rd were sent out shortly afterwards, having to call for volunteers from other corps. That has, unfortunately, been the system in our Army from time immemorial, and though, perhaps, volunteering of late has occurred more frequently than formerly, it was because we were carrying on two wars on a peace establishment. I entirely concur with Colonel Blundell that it would be most advantageous to have two classes of reserves—one available for small wars and the other for European wars. I believe myself, after an experience of some forty years amongst soldiers, that if there were different rates of pay for the two classes nearly every man would accept the higher rate of pay. If this pay was 6*d.* or 7*d.* for the first class, and only 4*d.* or 5*d.* for the second, he would elect to take the former, and we should then be able to fill up our regiments for small wars as easily as possible, more especially, as you must remember, the establishments of regiments are now on quite a different footing to what they were formerly. We have now twelve battalions in England at 950, we have four battalions at 850, one battalion at 800, and four at 650; the remaining battalions are at 500 and 480. I would advocate also a change many Officers will object to, that is, a reduction in the number of battalions. What is the use of those thirty-one battalions at home which, as Colonel Blundell so lucidly explained, would be reduced to almost nothing by calling for volunteers for the different corps abroad? Would it not be far better to have, say, twenty or twenty-four battalions at home 950 strong than to have all these paltry little battalions? And, without conscription, the ballot, or something of the sort, we shall find it difficult enough to keep the two corps d'armées in the field efficient. If the whole militia were called out in England, which would be the case during a great European war, they would be quite sufficient for home and colonial garrisons with the twenty-four or thirty-four line battalions which would remain. I trust that the Government will consider what Colonel Blundell has suggested with regard to the difference in the two classes of reserve men. I must say I do not agree with General Higginson in the remarks he made just now about the deferred pay not being popular or of any advantage to the men. And with regard to the desire of reserve men to come back to the Service to serve for pension there are a great many fallacies. If you remember when the men were called out about four years ago an offer was made that any man who liked might continue to serve with the colours. How many do you think accepted the offer? None. Those are the men that you see mentioned in the papers as having been hardly treated and sent away to starve. I am not stating what I do not know, but I am stating facts—there was not a single man who accepted that offer. Again, only a year or a year and a half ago the authorities tried to obtain 1,000 men from the reserve to come forward voluntarily. These are the men that they tell you cannot get work and

wish to rejoin regiments. How many came? The number has not been filled up. Therefore, I do not believe all the stories that are told; but I do believe that the men would come out manfully on a great national emergency, and that if the war was popular we should not have the slightest difficulty in getting any number of men. With regard to what Colonel Blundell has said as to the increase of wealth in this country, it has no doubt been immense, and why should not the insurance increase in the same ratio? If we have property worth millions more than we possessed years ago, why should statesmen grudge a fair proportionate amount to provide a thoroughly efficient Army as an insurance for the safety and prosperity of the nation? What is the amount of the Estimates in comparison with the wealth of Great Britain? It may be a large sum, but it is nothing for such a nation as ours. I do not think that Colonel Blundell would find many commanding Officers who would be induced to suggest great economies. So far as I know economies are not at all popular in the Army, and I also know the authorities are too much inclined to make economies, and to reduce, without consulting commanding Officers, not only allowances but also the clothing, which ought to be improved. The men are badly clothed, and they might be far better clothed at a very trifling additional expense. I will not trouble you with a long speech, but I beg to return our sincere thanks to Colonel Blundell for the very interesting lecture he has given us. He has shown us that he has studied the subject and thought over it deeply, and that there is a great deal to be done by Officers in the way of bringing forward to the notice of the authorities suggestions which may hereafter be taken up.

Friday, February 3, 1882.

ADMIRAL SIR FREDERICK W. E. NICOLSON, BART., C.B., Vice-President, in the Chair.

ON SIGNALLING AND CONVEYING THE ORDERS OF A COMMANDER-IN-CHIEF IN ACTION.

By Lieutenant CHARLES CAMPBELL, R.N.

IN accepting the invitation of the Council of this Institution to read a paper on signalling and conveying the orders of a Commander-in-Chief in action, I was fully aware of the difficulty of dealing with so large a subject, and especially in the limited time at my disposal. I am also aware that I am following in the footsteps of Officers whose ability and industry have caused them to be considered the highest authorities on the subject, and I could not help feeling that it might be presumption on my part to attempt the exposition of the question of "Signals in Action" in the presence of those who are more capable of dealing with it than I am. However, as I have been peculiarly fortunate in opportunities for acquiring knowledge of the working of signals in fleets, caused by my having served in flag-ships, and with fleets for many years, during six of which I was in charge of the signal department, I must put that, and the interest I take in the higher education of Officers and men in this important branch of their profession, as an apology for my temerity. There are many Officers who, from service in cruizers all over the world, cannot have had the same opportunities, and yet are deeply interested in the question; and to those I now address myself.

This paper is entirely for the purpose of raising a discussion on signals, and has no connection with the tactics, manœuvres, or evolutions of a fleet for action, which will only be mentioned to illustrate the manner of signalling suggested.

There are some who deny that signalling will be possible in action, and some who are of opinion that it will only be possible when the contending fleets become separated, and have to re-form at some distance apart from one another. I differ from both of these creeds, and join issue with those who believe that it is possible, with care and practice, to keep up constant communication in action, or I would not have done myself the honour of accepting the invitation to place this paper before you for discussion.

That communication by signal in action is important in these days when the moments which elapse between the Commander-in Chief of a fleet making up his mind what he will do and his doing it, may be counted on the fingers, everyone will allow. We shall require mobility,

flexibility, and, above all, cohesion, and to obtain this end we must have at least such a system of signalling as will ensure our being able to keep our fleet together.

Everything I have ever heard, read, or thought out on the subject of a fleet-action goes to prove that a sudden change just before attack, well executed, by a fleet in perfect order accustomed to obey instantly, would be the surest means of confusing and disconcerting the enemy; and a fleet with a quick method of signalling, which moves rapidly from one formation to another, will always be ready to take the greatest advantage of a sudden change, which of course we must be prepared for, on his part.

Captain P. H. Colomb, in his paper "On the Attack and Defence of "Fleets" (*See* No. LXVI of the Journal of this Institution) gave us a description of what, in the opinion of many naval Officers, the type of a naval battle would be to-day. He says, "The type of battle "would be a rush, a contact, a separation, a re-formation, again "facing each other, another rush, and the same thing repeated." Now, that is exactly where signals would be not only possible but absolutely necessary to insure uniformity of movement, and avoid confusion.

It has been stated in former discussions at this Institution that the Commander-in-Chief would arrange his plan of attack beforehand in the same way that the genius of Nelson planned the attack at Trafalgar. Granted that there would be plans of attack to meet certain formations of the enemy, still, as the Admiral cannot possibly know from what quarter and in what "perhaps hitherto unknown forma-"tion," the enemy may attack in, he may be obliged to alter his plans at the last moment, and he must have a simple and quick means of making his alteration.

It has also been stated that "the most important manœuvres "would take place before the action." I would suggest that this axiom would be more correct as follows:—"Very important manœu-"vres take place before the action," "more important manœuvres "take place during the action," and the most important manœuvres would be those which gave the *coup de grâce* and concluded the action. Therefore, on this assumption, we must leave no stone unturned in order to keep up communication right through the action.

There are at this moment a number of Officers who have given the subject the greatest study who are of opinion that it would be advisable to make considerable alterations in the principle and detail of making evolutionary signals, and this has arisen not from any factious or peevish desire for change, but from combined practice and study forcing on their minds the desirability of improving upon and adding to that which already exists. Never in the history of naval battles have the details so changed in any century, or between any two periods of naval warfare, as in this century, or between Nelson's victories and the coming battles of the future. It is needless to assert that we must improve our method of conveying orders so as to meet the increased celerity which all writers and speakers on the subject lay down as necessary for the destruction of our enemies.

It will not be necessary, and, in fact, would be impossible in the time, to review the history of past signalling; but I may refer those who are sufficiently interested in the subject to wish to know how we have arrived at the present system to two very interesting papers on naval and military signalling, read at this Institution by Captain P. H. Colomb, R.N., on the 29th May, 1863,[1] and the Monday evening following, where he relates, far more clearly than I can pretend to, the history of signals from the time of Polybius through the various changes caused by the introduction of the flag system in James II's time, the improvements by Kempenfelt, and the signal books of Sir Home Popham, published in 1801 and 1812, which gave us the basis on which our vocabulary signals are founded, whilst the traces of the older plans remain embodied in our "General Signal Book."

It will, however, be as well to notice a point which was in controversy at the date of the papers referred to, and which has since been happily set at rest by an amalgamation of the questions at issue. It was this: "That granted the use of a code or codes necessary, what "should be the form or method by which the numbers or letters of the "code should be transmitted? Whether should it be by form, colour, "sound, or motion?"

We have retained form and colour combined in our flag system, and motion in our semaphore by day when clear, and also motion in the flashing system by night, and we are using sound when the atmosphere is so dense as to render visual signalling impossible.

Those who have studied the various methods of signalling which have been made public this century will agree with me that these questions have now passed, with a satisfactory verdict, into the category of decided issues.

The present system of conveying orders by signals may be shortly stated as follows:—

In the first place, we have the "General Signal Book," wherein are placed the rules and regulations for the numeral code, action signals, evolutionary signals, which also would be used in action, and the general signals which are used in the ordinary conduct of a fleet. These codes are formed by the use of ten numeral flags together with some of the alphabetical flags as distinguishing signals and governing flags, and the distinguishing pendants—union jack, cornets, group and disregard flags—forty-eight in all. Next in importance we have the "Vocabulary Signal Book" for the distribution of explanatory orders before action, the use of which has been largely replaced by the semaphore, which has of late years come into general use. This book is numbered as well as lettered for use with the flashing system by night.

I do not purpose in this paper to refer to the "Manual of Naval "Manœuvres" as that book is intended for instruction, and is merely a reprint of the evolutionary part of the "General Signal Book," with additional notes and explanatory chapters, the code used being a mixture of commercial code pendants and naval numeral flags.

This, then, is a summary of the means of communication which we have at our disposal as far as codes are concerned.

[1] See Journal, vol. vii, No. XXVIII.

In addition we have the semaphore, already mentioned, for spelling messages by day, and the Morse alphabet for spelling messages by night, which are entirely independent of codes.

It may be well to notice here the extraordinary change that has taken place during the last fifteen years in spelling signalling by day and night. The semaphore at that time was looked upon as difficult and slow by the naval signalmen, simply because it was new to them. I remember in 1864 when taking in semaphores from the Palace at Malta, our custom was to take them in by the numbers answering to the position of the arms, and turning them into letters at the conclusion of the signal. This process was naturally slow and frequently inaccurate, and did not compare favourably with code signalling. On the 29th May, 1863, Captain Colomb gave a very convenient instance of the then slowness of the semaphore when discussing code *versus* spelling.

He said, in favour of code signalling: "We thus get at least a whole "word, and very often a whole sentence, expressed by four signs at "the most; whilst to spell the same sentence would require perhaps "four or five times as many. Such a sentence as 'army is going to "'land,' is expressed in the 'Boat's Signal Book' by figures 1594. To "spell this message by the semaphore, would occupy, say at the rate "of 7 figures per minute—which is full speed—3 minutes; to send it "by code only occupies 38 seconds. To this time must be added that "consumed in looking out the numbers in the code, both before "sending, and after receiving, which will be about 16 seconds, so "that on the whole operation, when the speed of transmission is "7 figures per minute, there is a gain of two to one in favour of "using the code. There is a speed of transmission, probably about "30 figures per minute, at which the code falls in arrear; but I do "not think there is any system applicable to the general purposes of "the Army and Navy which will attain that speed in practice."

Now any one who has lately served in fleets must be aware of the enormous stride that spelling by semaphore has made between that period, and the present time. Such a sentence as "army is going to "land," would be easily made in less than 15 seconds, quite as accurately, and at the same distance as flags can be distinguished.

The Morse for night work has not yet attained the speed of the semaphore, but there is no reason to doubt that it will; we may place the semaphore (worked by handles from the conning tower, or below the armour if necessary), as a powerful auxiliary to the action codes of the present and future.

For conveying the orders of the Commander-in-Chief in action, we mainly depend on the evolutionary part of the "General Signal Book," and upon the action signals. The former are made by the display of three flags, which may or may not be accompanied by a distinguishing signal or governing flag, and it will be readily acquiesced in, especially by those who lay great stress on the density of the smoke, that this seems a redundancy in number. It is true that what are termed the action signals, ninety-nine in number, consist of two flags only, but there are not sufficient combinations with the two numerals to enable

the evolutionary signals to be included. As a first principle, therefore, I would suggest that no signal likely to be used in action, or for any purpose of ordering an evolution, should consist of more than two flags, or a pendant and flag.

I am aware that this would necessitate a complete revision of the "General Signal Book," and could, I think, only be accomplished by the use of the vocabulary two flag signals, which have been omitted from the recent edition of the "Vocabulary Signal Book." They would give 420 action signals, evolutionary signals, and signals immediately relating to evolutions. This would be a first step towards abolishing the separate numeral code, and having only one set of flags consisting of a full alphabet, the first ten of which would act as numerals, when hoisted under the numeral pendant, but as the changes will probably take considerable time, and much necessary consideration, it will be sufficient in this paper to stick to the point, "that the "evolutionary and action signals should be made by hoists of two "alphabetical flags coded in the 'General Signal Book.'"

This change being made, we should have as our main, daylight, clear manner of conveying orders in action with a code, 420 two-flag action, evolutionary and correcting signals; the compass signals consisting of one pendant and two alphabetical flags for indicating the course to be steered, the bearings of leaders or ships from their leaders, &c.; and the signals for alteration of course by all ships together, which are made by the use of the compass pendant, either over or under numeral flags, according as the alteration is to starboard or port; besides the vocabulary and semaphore for explanatory instructions, changing the detail of the plan of action, &c.

In addition, and entirely independent of all codes and books already mentioned, I would suggest for discussion a system of ordering evolutions by the use of one pendant and one flag, or at the most two flags and one pendant. All the evolutions at present in our "General "Signal Book" are performed by the fleet when in line ahead, altering course eight points in succession; and then when formed in line ahead, at right angles to the original course, altering course eight points together, or in some cases, such as forming columns of divisions in line abreast, when a portion only alter at the same time; and "when in line abreast," first together, and then in succession, into formations in line ahead. We have at present in our signal books, as already stated, a most useful method of altering course together by the use of the compass (1) pendant over and under numeral flags, the number of points indicated by the numeral flag to starboard or port, according as the pendant is above or below the flags. I believe it would prove an invaluable adjunct to the code system, if the operation of the pendant and flag were carried a step farther by the introduction of the special pendant over and under numeral flags, as the signal to the leaders of whatever the formation the fleet are in at the time the signal is made, to alter course the number of points indicated by the numeral flag, to starboard or port acccording as the pendant is over or under the flag, the remaining ships of fleet, division, subdivision, or group following in succession in their wake.

I have selected the special pendant (No. 4) for this purpose, as at present it has no signification when used in conjunction with the numeral flags.

In addition to the above I would suggest to complete the system, "as "the compass pendant (1) when hoisted by itself has at present no "signification, that it should be used as an order to the fleet to form in "single line ahead" from whatever formation they happened to be in at the time it was hoisted. To enable this system to work all group formations, it would only be necessary to increase the operation of the group flag, which is at present used when hoisted singly to "re-form "groups," and, when accompanying an evolutionary signal, to "main-"tain group formation."

In suggesting the use of a group flag in 1874, my original statement was as follows:[1]—"What could be more simple than to take a numeral "flag which has at present no meaning attached to it, and make it "the group flag, changing the meaning of all signals made with or "after it to 'groups' working as single ships, until it should be "annulled by the Commander-in-Chief? When hoisted singly ships "of the fleet take up the group formation as laid down in the "'General Signal Book,' and remain and work in that formation as "one ship until the signal is annulled."

By this suggestion only one of the two group formations (starboard and port) could be formed, and therefore it was not carried out in full. Two signals being inserted in the code, one to form a starboard, and the other a port group. But in conjunction with the pendant and flag system already mentioned, I would suggest that the church pendant should be detailed for use with the group flag—over for a starboard group, and under for a port group. A numeral flag with this signal would denote the number of ships which were to compose each group. These changes being made, the fleet could be manœuvred in all the rectangular movements by the display of the compass (1) pendant, and as the alterations of course are always eight points, numeral eight flag, followed or preceded by the special pendant and eight flag.

In altering course to re-form or renew the attack any number of points between nine and sixteen, two flags must be used to indicate the number.

It will thus be seen that by the pendant and flag system the fleet can be manœuvred in all the evolutions laid down in the "General Signal "Book" and "Fleet Manual," moved from any position to any other position as a whole or in part, and put through any change of formation, including those which have not found room in the "General "Signal Book," or alteration of course at any distance from or in close proximity to an enemy.

The whole of these changes would be completed without reference to any code or book, which I maintain in a fleet action would be a very important point.

One of the greatest drawbacks to efficient signalling in action would be the exposure of the signal Officers and men with the implements of their vocation to the fire of machine-guns, and though

[1] Third Essay—"Gun, Ram, and Torpedo."

it is possible to hoist a signal through a hatchway, it will be difficult to keep the lookout that will be absolutely necessary anywhere but on deck, and in any case, I feel convinced, that the less they are hampered with books the better.

And, besides, the advantage to them of only having their heads to look after, the Commander-in-Chief himself, who is solely responsible, who has the whole plan and detail of the action in his brain, and whose whole attention would be turned to the conduct of his fleet, would in this case say exactly what was to be done, and would leave nothing to a chance interpretation of the numerous Captains under his command, who would at this time be worried on all sides with reference to the interior economy of their ships, and who would find it much clearer and more simple to receive an order to alter course together eight points, and then in succession eight points, or *vice versâ*, than to be obliged to read the explanations attached to most of the evolutionary signals.

Before illustrating this suggestion, at the risk of recapitulation I will read all the rules necessary to establish the system.

First what already exists.

"The compass pendant No. 1 hoisted over numeral flags is a signal "to the ships addressed to turn together to starboard the number of "points indicated.

"Hoisted under numeral flags is a signal to the ships addressed to "turn together to port the number of points indicated."

Proposed addition.

The special pendant No. 4 hoisted over numeral flags is a signal to the leaders addressed to turn together to starboard the number of points indicated, the remaining ships of their fleet, division, subdivision, or group following them in succession.

Hoisted under numeral flags is a signal to the leaders addressed to turn together to port the number of points indicated, the remaining ships of their fleet, division, subdivision, or group following them in succession.

The compass pendant (No. 1) is a signal to the fleet, division, subdivision, or group addressed to form in single line astern of its leader; church pendant—group flag, form starboard groups; group flag—church pendant, form port groups. With these simple rules as our guide, I will take any ordinary change of formation in order to show the simplicity, clearness, and precision of the proposed method.

Suppose the fleet is approaching in single line ahead, "head on" to the enemy, who is in the indented line abreast, and the Admiral finds that it would be convenient to attack his right in groups abreast: Diagram I, special pendant eight flag, alter course in succession eight points to starboard; then as the last ship in the line is about to turn, one pendant under eight flag, alter course together eight points to port, church pendant—group flag, and the enemy finds himself charged in groups abreast without a book or code having been opened by the attacking fleet, or its Captains having had anything to puzzle about except the preparation of their own immediate command for action.

DIAGRAM 1.

FROM LINE-AHEAD TO GROUPS ABREAST.

DIAGRAM 2.

LINE-ABREAST TO G

IN LINE AHEAD, TUR

GROUPS ABREAST FOR

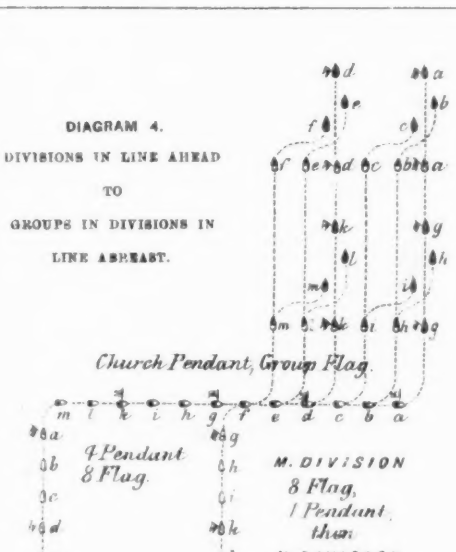
DIAGRAM 4.

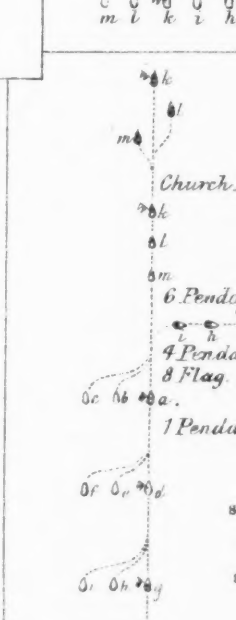
DIVISIONS IN LINE AHEAD

TO

GROUPS IN DIVISIONS IN

LINE ABREAST.





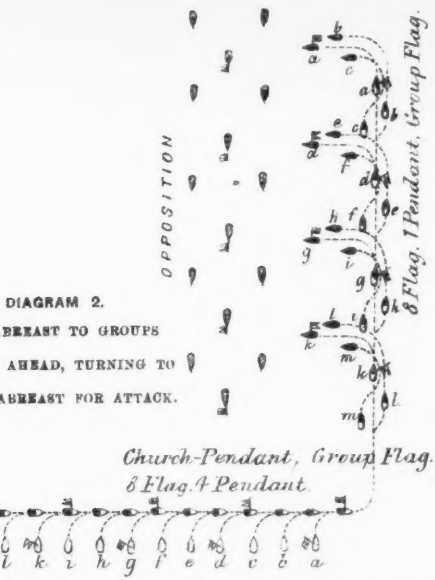


DIAGRAM 2.

BREAST TO GROUPS

AHEAD, TURNING TO

ABREAST FOR ATTACK.

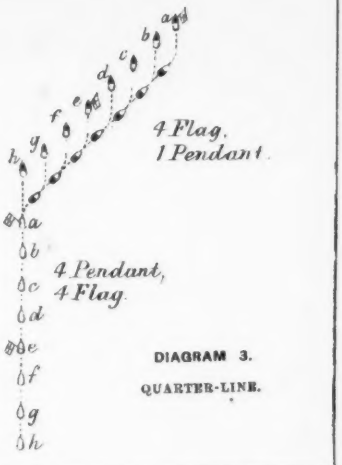


DIAGRAM 3.

QUARTER-LINE.

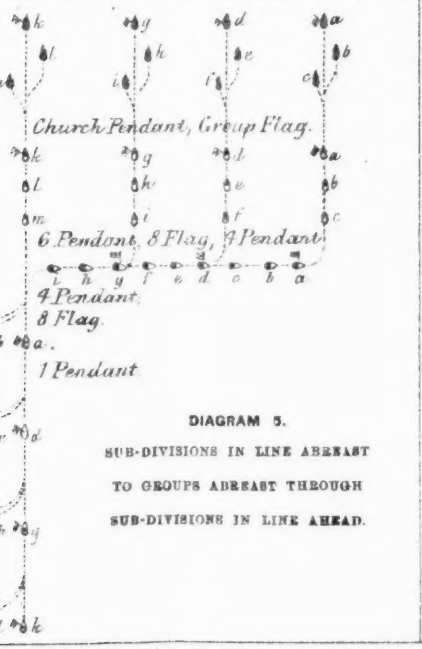


DIAGRAM 5.

SUB-DIVISIONS IN LINE ABREAST

TO GROUPS ABREAST THROUGH

SUB-DIVISIONS IN LINE AHEAD.

DIAGRAM 6.

WHEN GROUP MEETS

GROUP, ETC.

Or take the opposite case of the enemy in line ahead, the component parts of his fleet formed in *l'angle de chasse naturel* or pelotons. The attacking fleet is in line abreast, and the Commander-in-Chief wishes to attack in groups in line ahead along their port side, and then by a sudden movement pass through them: Diagram II, one pendant over eight flag would turn the fleet together eight points to starboard at right angles to the original course, immediately followed by the four pendant under eight flag, and the leader would turn eight points to port, the remainder of the ships following in succession until the fleet was formed in line ahead, when church pendant—group flag would form the groups, and then eight flag over one pendant together with the group flag would be displayed and hauled down at the exact moment to ensure passing through the enemy. Leaders of groups putting their helms over together on the signal leaving the masthead, remaining ships of groups forming on them in succession.

The port quarter line or échelon is formed from line ahead by first hoisting four pendant four flag, turn in succession four points to starboard, and as the last ship in the line is about to turn, four flag one pendant, turn together four points to port, and this line cannot be so formed, maintaining the speed of every ship, by any evolutionary signal.

The pendant below in the first turn and above in the second would form the starboard quarter line.

When the fleet is formed in divisions in line ahead, or in subdivisions in line ahead, the action of the pendant and flag would be precisely the same "as in single line ahead;" but if it is desired to form divisions in line abreast the use of the divisional flags in addition becomes necessary: for instance, to change from divisions in line ahead to groups in divisions in line abreast. Four pendant eight flag would turn the leaders of divisions into line ahead to starboard, the remaining ships of their division following them in succession. Then as the last ship of the first division is about to turn, M, the distinguishing flag of that division, eight flag one pendant, and the leading division would turn up together eight points to port into line abreast. As the leader of N division came about two cables from the wake of the Flag, N—eight flag—one pendant would be hauled down, and the second division would turn into divisions in line abreast, church pendant—group flag completing the manœuvre and forming groups in divisions line abreast. (Diagram IV.)

When a change is desired from subdivisions in line abreast to any other formation—say, groups abreast—in order to save a repetition of the divisional flags, the compass pendant would be hoisted by itself and the second and third ships of each subdivision would tuck in astern of their leaders. As the one pendant came down, the four pendant eight flag would be displayed, and the leader would at once turn; the remainder following in succession. Then six pendant (leaders of subdivisions) eight flag—four pendant, and the fleet is formed in subdivisions in line ahead. Church pendant—group flag forms groups abreast. (Diagram V.)

I will conclude the illustration of the pendant and flag system by supposing both fleets to be proceeding towards each other in groups abreast.

The Commander-in-Chief of what I will call the attacking fleet prefers the line ahead in groups, and as the fleet are already in the group formation, one pendant, hoisted singly, will complete that part of his intention. He can now, without further display of flags, steer for any part of the enemy's line he chooses, the fleet being bound by every rule of fleet manœuvring to follow in his wake. He decides to pass through between the enemy's right hand group and the next, and round on him with the eventual object of getting his bows to the enemy's sterns, and, therefore, as he closes he displays eight flag four pendant group flag, alter course in succession eight points to port, maintaining the group formation, concluding his manœuvre by hoisting eight flag one pendant, alter course together eight points to port, the absence of the group flag causing all ships in each group to turn simultaneously.

It stands to reason that the enemy may alter his formation, and so defeat the manœuvres of the attacking fleet, but in that case there is all the more reason for still more rapid changes on the part of the latter, and I have already stated that I am not proposing or defending any form of attack, but merely endeavouring to show how all changes of formation and methods of attack may be executed with the minimum display of flags and the maximum celerity, precision, and order, without reference to any book or code whatsoever!

It must also be borne in mind that the pendant and flag system is only proposed as an auxiliary, and not in any way to supplant the evolutionary code. One of its greatest advantages is that it is so simple, and takes no time or trouble to learn.

I venture to predict that anyone present who had not previously heard of the system could at once manœuvre a fleet with it.

In any case I shall be very pleased to hear their opinions for or against, or suggestions for improvement upon, what I have proposed.

Before leaving the portion of this paper dedicated to visual signalling when all is clear, I will call your attention to what has always seemed to me a fact worth noticing, and which I believe will prove more favourable to us in future than it did in former wars.

It has often been stated that, "Should a war break out which "would necessitate the massing together of a large ironclad fleet, we "should probably have a European concert against us, or at least two "formidable foreign Powers combined," and the question has again and again been asked if the British Navy could stand alone against the world? Looking at the matter from an evolutionary point of view, I would suggest that it would be a great advantage to us, as far as fleet actions are concerned, to have a combination against us. It was bad enough for our enemies at Trafalgar, when there was little or no manœuvring during the action. How much more would it be embarrassing to them now, when the victory will depend on the celerity of the manœuvres.

The Steam Siren.

It has been frequently stated by those who do not believe in "signals in action" that you cannot see anything, and it certainly must be conceded that in that case visual signalling must be superseded for the moment. But, when a fog comes on and envelops a fleet, they do not say, "We cannot see each other, we cannot signal." On the contrary, the visual system being at an end, the oral commences, and the fleet is conducted in perfect safety by sound alone. For some years this was done by the ordinary steam-whistle and the usual dot-and-dash code; but about four years ago the steam whistle was put in the shade by the introduction of the steam siren, which in ordinary weather can be clearly heard and understood at a distance of at least a mile and a half to windward and over four miles to leeward. I have myself taken in, when on board the "Minotaur," a Morse message two miles to windward of the "Invincible," and the Admiral in command was so struck by the clearness and distinctness of the sounds as they came to us, that he ordered me to ask the name of the signalman who was manipulating the siren, which was done, and the man's name and rank received in a few minutes by the same method.

It will require very little argument on my part to show how desirable the use of such a friend would prove when visual signalling had become temporarily interrupted by obscuration in action. Take it at its least use, namely, as a rallying-point. We will presume that the smoke will be at its thickest at the moment of impact between the two fleets, in whatever form the attack on either side may be made. The flag-ship leads through, or at least is probably equally advanced with the remainder of the fleet, and then wishes to collect her squadron, in order to re-form and renew the attack. The siren gives a sufficient means, and she can, without any change in any of the books, point out the direction in which she is standing by making the compass sign and the number of the points which she is about to steer.

Or if it were desirable, as has more than once been advocated, to turn sharp on the retreating enemy, and bring the bows of the fleet pointing to their sterns, "Compass 16" or "16 Compass" on the siren, repeated by repeating ships, would turn the fleet sixteen points to starboard or port together, or "Special 16" or "16 Special" would turn them either way in succession, and if necessary further signals might follow, such as the "group sign" to re-form groups, if the fleet had been passing through in that formation. In fact, there is nothing that can be made by the flashing system that the siren cannot make perfectly well, and I assume that when the smoke is so dense that you cannot see anything, the firing will to a certain extent cease, though I do not apprehend that it will interfere with siren signalling.

Employment of Torpedo-Boats as a Method of Communication.

We have now got a two-flag system by code, a pendant and flag system without code, and the semaphore and Morse when the wea her

is clear; the steam siren when the obscuration is so great that no visual signalling is possible.

As on the field, there is a time when the employment of a mounted orderly is found to beat "flag-waving," so on the sea there would be occasions when the use of messages by fast boats to pass an order from the Commander-in-Chief to his seconds in command and Captains would be found invaluable; and their use would probably take place at that vital moment when all other means had failed, both for ourselves and the enemy, which in all probability would be the critical period in a fleet action, when combined movement on the one side or the other would decide the issue of the battle.

Both in Lord Howe's action and at Trafalgar we know that the vessels went into action with their boats towing astern, and we have the most decided testimony that messages by boats were coming and going in the very heat of the action. It was after Mr. Scot, Lord Nelson's secretary, had been killed on the quarter-deck of the "Victory," that Captain Blackwood, of the "Euryalus," who had previously been on a message to tell the "Téméraire" she might pass the "Victory" if she could; having said "Good-bye" to Lord Nelson, who made use of the prophetic words, "I shall never speak to you again, Blackwood," again left the "Victory," with a message to the Captains of the line-of-battle ships to the effect that they were not to stick too closely to Nelson's plan of action if by doing otherwise they could sooner place their ships alongside an enemy.

It is true that the weather was very fine, and even with the crowd of canvas they were carrying, the ships were proceeding but slowly through the water, but I believe, with the command of engine-power, lowering apparatus, and high speed of boats, at a pinch, it may yet be possible to add this form of communication as an item in constructing our method of conveying the orders of a Commander-in-Chief in action. I was present when H.M. despatch vessel "Salamis" was used in this way, though of course not in action.

The Combined Squadron, under Lord John Hay, were proceeding out of Vigo Bay, when about to enter the narrow channel of the north entrance between Faroe Islands and the mainland, the fleet, consisting of twelve ironclads, without any warning, was suddenly enveloped in a dense fog. The Admiral directed me to hoist the signal to anchor instantly, and to semaphore to the "Salamis," which was steaming close on our port quarter, to proceed along the line with the signal flying, and report all ships anchored. She at once disappeared in the fog, returning in less than ten minutes, and reported the fleet anchored and in station. I merely give this case in order to illustrate the manner in which quick steam-boats might be used in order to convey messages along the line. It is astonishing how keen the perception becomes, and how quick people move under the excitement of real work, and we will hope that a fleet action on the open sea will be sufficiently exhilarating to produce some sharp results in communicating the orders of the Commander-in-Chief to his ships, either by sight, sound, or boat.

Training of Officers and Men for Conveying the Orders of the Commander-in-Chief in Action.

Having the means of conveying orders already noticed, it only remains to instruct the Officers and men who are likely to use them, so thoroughly in every detail, that there need be no fear when the supreme moment arrives, but that the orders of the Commander-in-Chief will be understood, no matter by what method or medium they may be conveyed.

First, with regard to the Officers: I have for many years been anxious to see a regular system of training in signals and tactics established in our Service, through which all Officers must pass. As a proof that I have for some time past thought out this question, I will quote from an essay written by me for the "Junior Naval Pro-"fessional Association," in 1873, in which I stated as follows:—[1]

"As there is at present no special training for Officers in signals "or in the tactical manœuvres of a large fleet at sea, unless a young "Officer happens to be stationed in the signals when the ship to which "he belongs is with a fleet, he grows up knowing little or nothing "about it. I sincerely hope, when the value of the knowledge of "tactical evolutions has become more recognized, that a 'short course' "will be opened for the Officers who wish to become acquainted with "that important branch of their profession, somewhat similar to the "'gunnery short course' which all Officers may now attend."

Since writing the above I have had the honour of serving for five years at sea in charge of the signals in the Flying and Channel Squadrons, sometimes with as many as twelve ironclads in company, and I am more than ever convinced of the value, I may almost say necessity, of such a course.

I will now quote one or two opinions from some of our ablest Officers who have spoken and written on this subject, in order to show that I am not alone in the desire I have expressed. All are not agreed as to the means, but all are agreed as to the want of "systematic instruction in signals," and in the evolutions for which signals are but a means of conveying the order.

In discussing Captain Colomb's paper "On the Attack and Defence "of Fleets," Admiral Sir Houston Stewart concluded his remarks by saying, "It is a most important and vital point that every Officer in "the Navy should be thoroughly instructed in the theory of steam "tactics."

Vice-Admiral Randolph in discussing the naval war game, after praising the ability with which our ships are commanded, qualifies his praise by saying, "I fear there are a great number of Officers on the "list who have not had experience at sea, and who would be found "deficient and failing in proficiency if they were called upon to serve. "I therefore feel the greatest anxiety that further steps should be taken "towards the establishment of a systematic method of training our "younger Officers in the practical work of handling their ships at "sea."

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And, again, further on he says, "I hope to live to see the day when "the profession will be trained under a system, and so thoroughly "that we should incur no danger of losing our position in the naval "world."

Opinions agreeing with these Officers have been given by Admiral Inglefield, the late Sir H. Codrington, Captain Noel, Mr. Laughton, and many other Officers in our Service, notably those who were asked their opinion by the Committee on the Higher Education of Naval Officers, 1870, who almost without exception gave tactics as a desirable element in naval education.

And if we look abroad we have the strongly expressed opinions of Admirals Jurien de la Gravière, Le Compte de Gueydon, Touchard, Bourgois, Lieutenant de Penfentenyo, of the French Navy, Admiral Boutakov (the author of the system of tactical instruction established in the Russian Navy), Lieutenant Semechkin (author of a course of lectures on steam tactics, delivered at Cronstadt) of the Russian Navy, and many others, all in favour of systematic instruction in signals and evolutions.

To pass all Officers through the evolutionary squadrons presents difficulties, which are practically insurmountable, but we are doing the best we can in this direction. The only way to reach all Officers is to take them as Sub-Lieutenants when they go through the college "Excellent" and "Vernon," and give them a month or six weeks at the principles of signalling and the elements of naval tactics, concluding with launch ramming practice.

Also a more advanced course for Lieutenants on their promotion, and allow a certain portion, who have an inclination that way, to study and qualify as tactical Lieutenants. The expense need be very small; twelve steam-launches, as old and rickety as you like, with their sides padded and a ramming apron or a bow cushion. The lecture-room already exists.

The only instruction that has actually been given to the junior Officers other than that "picked up" at squadron exercise was commenced in Sir William Martin's squadron, with the boats under oars, up and down the harbour of Valetta and elsewhere, a practice highly commended by the late Commander Pellew and the speakers on the paper he read at this Institution in 1863. The introduction of steam-launches rendered it possible to make this form of instruction more nearly resemble the actual manœuvring of ships, and their use for this purpose was ordered by the late Admiral Warden when in command of the Channel Squadron, Admiral Inglefield taking the steam-launches at tactics in the open waters below Lisbon, and he afterwards stated in discussing Captain Colomb's paper "On the Attack and "Defence of Fleets," "that he found it an admirable way, and at a "cheap rate, of teaching the younger Officers to practise in naval "tactics."

It was not until 1877 that this form of instruction was reduced to a system, and the boats of the Channel Squadron regularly exercised at all ports, every Lieutenant of the fleet going through a regular course of the Manual in his turn.

During the combined Channel and Reserve cruizes of 1879 and 1880 twelve steamboats were constantly out while in harbour. Captain H. Rawson kept regular lists of the Officers who went through, and the manner in which every evolution was performed. I have never heard any one even doubt the success which has attended this system of instruction, and it is principally for this reason that I would suggest that all Officers should go through such a course as early in life as possible, returning to it again and again as opportunity offers, or necessary alterations in tactics render it advisable.

Taking the space required to exercise the boats in, and the accommodation for Officers under training, into consideration, the old College at Portsmouth seems most suited to carry out this work, and the course might take place after the "Vernon" course.

Instruction of Signalmen.

Nearly every argument which has been brought forward in favour of the systematic training of the Officers applies with double force to the men, and where the Officers are instructed there would be a great advantage and little or no more expense in training the signalmen at the same time and place.

The men have this advantage over the Officers: they are picked as boys from the upper school in the training-ship, and carefully instructed in that line in which they remain during the whole of their service.

There is, however, a period between their service in one ship and the time they are again drafted to sea, when they are liable to forget a great deal of what they have been taught.

Now, instead of allowing this period to act as a minus quantity in the career of a signalman, I would propose that all signalmen, being paid off from whatever ship they may have served in, and having had their leave, should return to the signal instruction depôt, wherever that may be, and go through a regular course and examination for higher rate or confirmation of those given them while serving abroad.

They should attend the boat tactic course in order to attain a thorough knowledge of the application of the evolutionary signals.

I believe that besides the actual gain instead of loss in the abilities of the men, a more uniform idea of "how signals ought to be made" would be the result.

The time has come when "bunting tosser" should cease to be a term of reproach. I can safely bear testimony to the great and growing intelligence of hundreds of signalmen whom I have had the honour of training during the past ten years, and I assert that their place in action in these days of machine-guns will be at least as warm as that of any of their shipmates. They, under an Officer, will be the medium through which the orders of a Commander-in-Chief in action will be conveyed to his Captains. Therefore, any additional trouble or expense incurred to ensure their efficiency when the day comes will, I feel sure, not be thrown away.

In conclusion, I would like to suggest for discussion whether some plan might be adopted in our fleet for manœuvring under blank fire.

Twice during the last ten years I have been present when the two divisions of the fleet separated, and then passed each other in groups, firing tubes, and once when the fleet steamed past a target in single line firing shot and shell, and on one occasion a memorandum was promulgated, giving the detail of an intended "passing in groups," firing blank cartridge. But, I think through a portion of the squadron being ordered home, the manœuvre was not carried out, and we lost a chance of practically testing the smoke question.

I believe great benefit would accrue to our Navy were a system of tactics under fire generally adopted.

As in all exercises where a supposed danger exists, a certain amount of caution would be prudent at the outset. For instance, we might safely begin by separating in pairs, and the two ships in each pair form abreast of each other at 2 or 2½ cables distance. The guns would be loaded with blank, and the ship on the port hand would put her helm hard-a-port, firing her starboard broadside, then, as she came head on, her bow guns, and, as she passed astern of her consort, her port broadside. The ship on the starboard hand standing on and firing her port broadside, stern guns, and then starboard broadside. Some idea of the extent to which smoke will prevent signals being seen and heard when at close quarters might be gained even in this simple evolution.

Divisions in line ahead might safely pass each other at 4 cables with the same object in view, and groups at from 4 to 6 cables.

Highly-trained gunners and torpedo-men we have, and their value cannot be estimated; but Captain Long, R.N., likened naval warfare to one of those curious locks which can only be opened by the combined action of a number of keys, and it is only by the cordial co-operation of those interested in construction, speed, gunnery, torpedoes, and signals, that the jewel of naval supremacy can shine with increased lustre on Britannia's brow! Trained signal Officers and men can alone ensure the Commander-in-Chief, by the rapid distribution of his orders, being able to develop to the utmost extent the power of the gun, ram, and torpedo.

A squadron practised in signals of all kinds, and accustomed to look out for signals, and obey them instantly, holds within itself an invaluable element of success;[1] and on the day when fleet shall meet fleet in one mighty effort of destruction, happy the Admiral in command, to whatever nation he may belong, who shall find, 'midst the crash of the charging masses and the din and turmoil of battle, that his orders are understood and obeyed, and his Captains possessed of that unity which is strength, and that knowledge which is power.

Vice-Admiral DOWELL, C.B.: This is a subject in which I am very much interested, and I feel much indebted to Lieutenant Campbell for having brought it before us in so able a manner. I fully concur with all that he has said as to the necessity of having signals in action. Our battles will be battles of manœuvres, and, as Lieutenant Campbell says, when vessels sight each other they will be going from eight to twelve knots, and approaching at that speed, the Admiral will have only

[1] Essay on Tactics, 1879.

seconds in which to decide what he will do. As the enemy advances, it may be necessary for him to alter his formation at the very last moment, which can only be effected by signals; after he has once made his charge at the speed he is going, he will have to turn, re-form, and attack again, which also must all be done by signals. The question then is, what signals will be most available in action? I do not pretend without more consideration to offer an opinion about Mr. Campbell's proposed plans of flags and pendants, but I am quite convinced that his principle is the right one, that the fewer flags we have to hoist, the less chance there is of a mistake. After all, this is very much upon the same system as that in our "Fleet Manual," which consists of pendant and flag, or pendant and two flags. This plan was adopted, because these flags are fewer to hoist, more easily seen, and the book is more convenient to carry about with one; but if the book can be done away with, so much the better. I think, however, that the flag signals should be supplemented by the semaphore, and that every ship should have a set of semaphores at the mast-head, to be worked under cover through the mast, and used in addition to the flags. Also that we should be prepared to use the siren, when the smoke is so thick that nothing can be seen. I should like to ascertain by trial how much guns would interfere with the siren. I think it might easily be tried, by firing blank cartridge, and at the same time making signals with the siren. Signals being indispensable, if they cannot be made in one way, you must make them in another. It is the fleet that signalizes best, and quickest alters formation, that will win the day. I quite agree with what Lieutenant Campbell said about the training of signalmen, that it is a necessity. Much more attention is paid to it than there used to be, but they ought, I think, to be specially educated from the very first day they join the training-ship. It is not necessary that every man, because he understands signals, should go into the Signal Department. You should make many more than are required there. As Lieutenant Campbell says, the signalmen and the Signal Officers will be the first men picked off by machine-guns in action, and therefore everybody should be qualified to be available to take their place. And all Officers should understand signals. With reference to Officers, I quite agree with the plan of training them in the boats, but that is only to give them a knowledge of the signal book. It will not give them the experience necessary in managing fleets. A man may manœuvre a set of boats beautifully, but put him on board a ship, and very likely he will make a mess of it. The only way it is to be done is in our fleets at sea. One reason why it is so desirable that our evolutionary squadrons should be constantly cruizing is that there may be sufficient time to train everybody. This was done in the Mediterranean Squadron, and I know in Sir Geoffrey Hornby's time, by his occasionally ordering that the Lieutenants were to be entirely in charge; the Captain was to be at hand to prevent accidents, but the whole of the evolutions were to be performed by the Lieutenants themselves, all orders given, and all signals made by them. I believe this is the only way thoroughly to train our Officers.

Captain BOWDEN SMITH, R.N.: I am very glad to have the opportunity of offering a few remarks on the lecture to which we have just listened, I may say with so much pleasure, from Lieutenant Campbell. The subject of communicating by signal in an action, and conveying orders from the Admiral to the Captain, is a most important one, and one that has not perhaps been sufficiently considered. It has been urged by some Officers, as Lieutenant Campbell observed in his lecture, that there would be in a naval action, perhaps on account of smoke, and from other causes, little opportunity of signalling after the action is once commenced, but I think it is not at all the case. What is our ordinary every-day experience at the present moment on board ship? Why one of the first things we think of on going on board is our means of communication; even if we are by ourselves away from the fleet, if we have to send anybody to assist a vessel in distress on the high sea, or to get a vessel off shore, or to send people away to the dockyard, or in boats, if these people are likely to be in sight of the ship, and to possibly want further advice or assistance, we always request that a signalman may be detached with that party, with a semaphore if by day, or a flash-light if by night, so that we may know what is going on, and if necessary, promptly send more force or further assistance. Then again, in a fleet at anchor or at sea, the semaphore is always going on; we cannot do without it, and are we to suppose in the supreme hour of action, we can possibly

dispense with a means of communication one to the other? Unless a combined action is to be fought at sea, that is to say, unless there is some plan or system of attack prepared beforehand, and unless the Captains by communication with the Admiral, and with each other, endeavour to carry out that plan, a naval battle, after the first onslaught or attack, would merely be a free fight between a certain number of ships on either side, each one playing his own game, and paying no attention to each other in combining to deliver a decisive blow upon the enemy, or by mutual assistance combining to resist a deadly attack from him. It appears to me, therefore, it is absolutely necessary to have, as Lieutenant Campbell and Admiral Dowell have said, means of communication at sea. I think myself there ought to be a semaphore on each side of the ship, in a conspicuous place, always erected in time of action, the men working it being protected from rifle-fire by plates or hammocks; and there ought to be a spare semaphore on each side to take its place, should the one in use be shot away. If the ships were arranged in pairs, as I think they ought to be, then although very often the ships might not be able to communicate with the Admiral or divisional leader, yet rapid and valuable communication might take place between a pair of ships that could not be joined in by a third or more. I think in that case very valuable use may be made of the semaphore. Flags are generally hoisted from the poops and bridges of ships, and we ought to arrange plans so that the flags should be hoisted from places where the men could be fairly protected from rifle-fire. Lieutenant Campbell's suggestions as to the alteration of the flags seem very practical, I mean in reducing the flags in the hoist and making the thing more simple. I think this is well worthy of attention, and I hope it will be taken into consideration. A good system of making signals in action is a thing of the greatest importance, and one to which we cannot give too much attention. A ready means of communicating our ideas at sea may enable a fleet of ships by skilfully combining to give a crushing blow to one portion of the enemy's fleet at a time, and thus render the other portion an easy prey; or after a successful attack has been made, and an advantage has been gained, it may enable us, by quick signalling, rapidly to deliver a decisive blow, which would finish the action. Or should one of our own ships be hard pressed, and temporarily disabled through some cause or other, such as injury to screw or rudder, her sister ship or fellow, the other one of the pair to which she belongs, might, if rapidly told the condition her consort was in, come to her assistance, and so perhaps run down, or at all events frighten away, the would-be destroyer of her fellow. I am not going into any criticism of the plans put before us, because I understood Lieutenant Campbell to say they were merely placed there to illustrate the system of signalling, but I should like to say, I have always been against groups of threes, and I can see no other system there represented. They are all in groups of threes. I am afraid in what I have said I have the majority of my brother Officers against me. There is a liking for these groups of threes, which I am afraid is not the best system, and is likely to lead to disaster. I remember on two occasions in Besika Bay, we had twelve ships together, and in groups of threes. We were steaming in narrow waters, and when we came to alter course, as we had to do, even standing on the poop in perfectly fine weather, with nothing to distract one's nerves, when the groups came to turn about, for several minutes it was really impossible to distinguish them one from the other. I came therefore to the conclusion that if that kind of formation was carried on in action, it would very likely lead to disaster. I think also, if ships were worked in pairs, the semaphore could be used with much more advantage than it could in any other way. I congratulate Lieutenant Campbell on his lecture, which I am sure will bear very good results if it leads us to give more attention to this subject.

Vice-Admiral Boys: I merely rise to add my tribute of thanks to Lieutenant Campbell for having brought this important subject before the Institution. It is exceedingly difficult to follow a series of diagrams of columns and groups like these before us, and the signals attached to them, without previous study, but I must say I agree entirely with Lieutenant Campbell's principle, in his advocacy of signals that do not require any reference to books. You can easily imagine that the fire from the enemy's machine-guns would be directed upon any exposed part of the ship from which signals were being worked. In the case of the "Agincourt," the other

day, we had no less than thirty-five persons employed on the signals, including the Flag Lieutenant, two Sub-Lieutenants, and a Midshipman, and in that ship of course they must have been entirely exposed while carrying on their duties. I think a question that requires more attention than has been given to it is the protection of the signals and particularly of men who must be exposed on a ship's upper deck in action. One of the best plans for this purpose that I have heard of is by placing rifle-proof steel plates in the form of a cross, with a dome over them, in different positions about the deck; this has been proposed, but it has never been carried out. Signals are necessary during an engagement, and I think that is the best way of protecting signalmen who must be exposed to a very great extent. Then with regard to the smoke question, my own opinion is when ships are steaming at a high speed, the smoke is not such a detriment to fighting operations as is generally supposed. I can speak from a little experience in the case of the turret squadron which I had under my charge two or three years ago. We went out twice from Portland for target practice, and we steamed in line ahead in close order past the targets, and found no inconvenience from the smoke.

The CHAIRMAN: Was there much wind?

Vice-Admiral BOYS: There was a moderate breeze, but in a column we also could steam out of our own smoke. I think it will be one condition of fleet actions in the future, as it was in the past, when every Admiral tried to get the weather gauge, that now every Admiral will try to take a postion of advantage in respect to smoke. With regard to the training of Officers, I agree as to the importance of having an educated staff of Signal Officers and Signalmen, and my own view is that they should be placed in the same category as Gunnery and Torpedo Lieutenants. I think every Sub-Lieutenant and every Officer, when he passes, should be required to have a certain amount of signal knowledge after going through a short course, but there should be a distinct staff of Signal Officers and men receiving extra pay, as seamen gunners do. I think it is of actual necessity that such should be the case. I will only add that I am sure we must all thank Lieutenant Campbell for his lecture.

Commander KINGSCOTE, R.N.: I should like to say, from my experience of last year, when serving with the Reserve Squadron, that we could hear the siren most clearly, and at a great distance. I imagine that everybody would be glad if every ship had its siren. I believe also that the siren would be of the greatest use in a fleet action; if so arranged that it could be worked from inside the turret, so that the Captain would have full command of it, and could use it himself as he liked.

The CHAIRMAN: May I ask if you propose that every vessel should have a siren?

Commander KINGSCOTE: Yes.

The CHAIRMAN: Would there not be great difficulty in distinguishing from which vessel the sound was coming when they were all pretty close together?

Commander KINGSCOTE: I think, with experiment and modification, you could alter the sound of the siren, by placing a valve or slide in front for instance.

The CHAIRMAN: As I understand you, each vessel is to have her own voice as it were?

Commander KINGSCOTE: Her own voice certainly.

Commander GILMORE, R.N.: I entirely approve of the signal system as described by Lieutenant Campbell, and my only object in rising is to introduce Captain Barker, of the United States Mercantile Marine, who is present to-day, and who has invented a system of fog signals by which you can use any code you like. It is a steam siren which can be worked by hand at the discretion of the signalman. Although Captain Barker merely intended this for the mercantile marine, and for the safety of ships travelling on the high seas, it can, I am sure, be adopted in fleet manœuvres, contrived as the siren is to give long and short sounds, thus indicating the course steered, or to be steered. Captain Barker would be very glad if the Council would allow him to bring his apparatus here, and to read a paper on the subject.[1]

[1] Paper read on the 20th February.

Lieutenant CAMPBELL: As everyone has been so kind as to agree with what has been said, I should only like to say before sitting down, that although I have advocated systematic instruction, I am not one of those who make unfavourable comparisons between this country and other nations. On the contrary, in our method of transmitting orders by signal, I know we are ahead both by day and night. I entirely agree with those who believe that when the day comes for the first line of attack and defence to make an effort, so will the Admiral be found to guide our fleet, and Captains to manœuvre our ships, so that order will be maintained, and confusion avoided. And more than this, we had conclusive proof only a few weeks ago that when the occasion arises, our Captains will display as much personal heroism, fighting to the last gasp—aye—and die as game as ever they did in the glorious days of our forefathers.

"He died in trying to free the slave
"Far and wide the tale will ring,
"And many a gallant deed will spring
"From Brownrigg's grave."

The CHAIRMAN: I have now only to ask the meeting to give its cordial thanks to Lieutenant Campbell for his paper. I think every speaker has agreed with the suggestions he has made of measures that should be carried out, so that criticism seems to be absent on this occasion. We are all highly pleased to find that the younger members of the profession are alive to the new ideas and new plans of the day, and are ready to come forward and give us, the older hands and the two Services generally, the benefit of their ideas and their knowledge. The object of the Council of this Institution is that, throughout the two Services, men in active employment especially should come here and read papers and have them discussed, a proceeding which must tend to the great advantage of those Services the more it is done, and the more openly questions are discussed in this theatre; I beg therefore to render our best thanks to Lieutenant Campbell for his valuable paper.

Friday, February 17, 1882.

COLONEL SIR LUMLEY GRAHAM, BART., Member of Council, in the Chair.

THE TRAINING OF TROOPS FOR WAR.

By Colonel R. HARRISON, C.B., R.E., A.A., and Q.M.G. Aldershot.

CONTENTS.

	Page
1. Importance of subject—Definition of the term "Training"	75
2. System of training in the *past*—The Grecian Phalanx—The Roman Legion—The English troops before the Peninsular War—The French armies under Napoleon—The Germans in 1866 and 1870	76
3. Is the present system of training in the English Army all that is required? Recent defeats seem to show that it is *not*	78
4. Assuming that it is *not*: How, under the present organization, can it be improved?	79
5. Principles of Army instruction—Education of a recruit—That of a 2nd class soldier (or technical recruit)—and that of a 1st class soldier	80
6. How to carry out a system of army training.—Text-books. The instruction of Officers. The training of men. Inspections and returns. Summer drills and manœuvres	84
7. Statistics to prove practicability of proposals	88
8. Résumé of arguments, and conclusion	89

No one can deny how all important it is that any country which requires to keep up a military force should have a good system by which her troops should be thoroughly well trained for war.

The process by which armies are created is the same everywhere—first comes *enlistment*, then follows *equipment*, and lastly comes *training*. Of these three steps the last is certainly not the least important.

Well trained troops have often conquered, though badly fed, and in rags. Badly trained ones, however well "found," have almost invariably been beaten.

It must be borne in mind that when I speak of training, I do not mean the few months' drill which is given to the infantry recruit on joining the English Army, after which he is considered fit to take his turn at "guards," and other duties. But I mean the whole process by which the recruit is transformed into the soldier. I mean the education which teaches the individual all the duties which can be required of him in war, and renders him as fit as possible to undertake them. These duties will be alluded to, and the course of instruction dealt with at greater length further on.

But before going into these details, let us consider for a few moments what have been the advantages of a good system of training in one or two notable instances in the days that are past.

Who has not heard of the wonderful victories gained by the little States of ancient Greece when attacked by the overwhelming forces of the Persian monarchs?

Who has not heard of the conquests of Alexander the Macedonian, when he led the troops drawn from these same States against the entire civilized world?

But how many of those who have read those thrilling tales have studied the elaborate organization of the Grecian "Phalanx;" or have thought over the carefully arranged course of training that every member of that military body had to go through before he was considered fit to take his place in the ranks?

Those who have done the latter will perhaps agree with me that it was *training* which went far to enable those levies of Greece (the militia as we should call them in these days) to beat the regular armies of Persia and the East. For, as soon as that training began to drop—when luxury and the love of gold got the better of the simple habits that the Athenian and the Spartan soldier had hitherto been proud of; when the exercises with sword and spear gave way to lolling in the verandahs of the bath, the Greek Phalanx, till then invincible, was beaten; and soon after the stranger stood as master even among the hills and valleys of the Peloponnesus.

The history of the Roman Legion teaches the same lesson.

M. Rocquancourt, in his book on military art and history, tells us how the ancients, who seldom kept up standing armies, used to gather together, at certain seasons of the year, all those citizens who were fixed upon as fit to bear arms, in order to train them for war, by exercises, marches, and sham fights.

In the days of the Roman Republic the recruits were exercised every day, morning and evening, in the use of arms, and the citizens (even those who had some previous knowledge of war) used to go continually to the Field of Mars (their great drill ground), in order to practise military evolutions. Their whole soul was in war, their whole time was devoted to learning the art of battle; and, as the historian Josephus said, their peace manœuvres were so like war, that one might have called their manœuvres bloodless battles, and their battles "death-bringing" manœuvres.

The lessons learned during the Republic were not at once forgotten. They lasted through the reign of more than one Emperor. But at last riches and luxury got the better of their warlike zeal, and then (and not till then) the Roman legionary (like the hoplite of the Grecian Phalanx) was forced to bow his neck beneath the conqueror's yoke.

But it will be well to take examples from modern as well as ancient times.

The fact has been pretty generally acknowledged that the admirable training given under the direction of Sir John Moore to the British troops assembled on the south coast of England, as a guard

against French invasion, laid the seeds of the army which, in after years, under Sir Arthur Wellesley, cleared Spain of her invaders.

In Sir J. Moore's life we read that "the troops were trained to exact discipline by Moore, who possessed the valuable talent of instructing the Officers in their duties, and of rendering the soldiers expert in the use of their arms, and swift in manœuvring, without distressing them with multiplied and vexatious orders."

And again, it was the marvellous and accurate training that the French Army at Boulogne received from the Emperor Napoleon, that enabled that army to execute with complete accuracy the most wonderful of all the campaigns planned by that great General, which terminated in the decisive battle of Austerlitz.

Sir Archibald Alison in his well-known history, in speaking of the French organization and training at the above-named camp, says: "During its long encampment on the shores of the Channel, this great army had been organized in a different manner from any that had yet existed in modern Europe. It is a curious circumstance that the genius of Napoleon, aided by all the experience of the Revolutionary Wars, reverted at last to a system extremely similar to that of the Roman legions; and to the vigour and efficiency of this organization, which has never since been departed from, the subsequent extraordinary success of the French armies may in some degree be ascribed."

In this Boulogne camp "neither Officers nor soldiers were allowed to remain any time idle. When not employed in military evolutions, they were continually engaged either in raising or strengthening the field works on the different points of the coast, or levelling down eminences, draining marshes, or filling up hollows, to form agreeable esplanades in front of their habitations, and where their exercises were performed. The different corps and divisions vied with each other in these works of utility or recreation; they even went so far as to engage in undertakings of pure ornament; gardens were created, flowers were cultivated, and, in the midst of an immense military population, the aspect of nature was sensibly improved. Satisfied with their lot in this great encampment, the soldiers were singularly tractable and obedient. Constantly occupied and amused by the spectacle of sea fights, or frequent reviews, and mock battles, they neither murmured at the exactions of a rigid discipline, nor experienced the usual monotony and languor of a pacific life in camps."

Lastly. I cannot entirely pass by (although so often quoted) the most startling example of the result of training that the world has ever seen.

It is acknowledged by all thinking writers that it was quite as much by the careful training of all ranks as by the provision to its infantry of a rapidly shooting firearm that the Prussians, who had had no experience of war (save the Danish expedition) for fifty years, beat in seven days the war-experienced armies of Austria; and that it was as much by the training of her troops as by the superior numbers brought into action at the decisive points that Germany swept off the field in seven weeks all the regular armies of her warlike western neighbour, most

of whose Generals, and many of whose Officers and men, had had practice in war either savage or European.

It would be easy to multiply cases or to go more at length into those which I have quoted. But I think enough has been said to establish the fact (in the abstract) of the importance to an army of training for war.

Let us now turn to a more personal matter and inquire, is the training for war in the English Army all that is required?

Should we come to the conclusion that it is not, we will then proceed to discuss whether under the present organization it is possible to improve our system of training, and, if so, how such a measure can be brought about.

The series of disasters that have befallen the arms of England of late years show, it seems to me, conclusively enough, that something must be wrong with her Army system, and I do not think it would be difficult to prove that the fault lies chiefly, at all events, in want of training.

Some may, perhaps, say that in the recent wars wherein the disasters alluded to occurred, the leading of the troops was not what it should have been, and that the arrangements for the march and the camp were defective. Allowing, for the sake of argument, that these faults existed, is it not the same thing as to say that there was want of training? For would not a system that was worth anything comprise not only the education of the soldier, the non-commissioned officer, and the regimental Officer, but also that of the Staff?

It was the wonderful power that they possessed of handling troops (the result of their admirable system of training) that made the German Generals so good that, among the large numbers employed in the wars of 1866 and 1870, so few committed any serious fault.

But, again, it may be said by some that the disasters to the English arms above alluded to were caused by our defective Army organization, that the fault lay in weak battalions and young soldiers. Against this it can be answered that in the four notable disasters of Isandlwana, the Intombe River, Maiwand, and Majuba, the troops which suffered defeat were seasoned soldiers. In the first-mentioned, indeed (Isandlwana), the soldiers who were killed almost to a man by their numerous athletic foes were stated to have been as fine a body of men as had existed at any period of our Army's history.

It has been too much the custom in England (especially of late) to try and explain away military disasters, either by throwing blame on commanders, or by imputing want of courage to the troops, instead of investigating the real reasons for them, and applying the necessary remedy. Now, the more I study the accounts of our defeats in South Africa and Afghanistan, the more convinced I am that "want of proper training for war" has been the chief, if not the only, culprit. I might, no doubt, in confirmation of this opinion, proceed to explain the process by which thoroughly trained troops take up a position for defence, or how they occupy ground in attack; and I might proceed to show in what particulars this process was not gone through in the instances

alluded to. But such a course would probably lead to discussion on tactics—a subject quite distinct from the one I am now dealing with, and which I have consequently endeavoured to avoid as much as possible.

After all, it is perhaps unnecessary to show by *examples* that our troops of the present day are deficient in "training for war," for most, if not all, regimental Officers will say they know it, and they lament it; and, in indignant sorrow for the disasters that have fallen so thickly and heavily on our arms in recent years, they cry for the old system under which our troops were almost universally victorious, and curse the changes that have upset that system as the cause of our troubles.

"How," say they, "can we train our troops more than we do? Our recruits come irregularly; our Officers and non-commissioned officers who have become fit to act as instructors are taken away from their regiments for various external duties; our numbers are perpetually shifting. It is as much as we can do to furnish the heavy drafts required to fill the gaps in our linked battalions that are abroad, and the few duty men that we have available are absorbed by the ordinary garrison and regimental duties customary in all British stations."

Well, I acknowledge that there are difficulties, and I am not going to say that I think the Army system we have now is *perfect;* but what I do say is that we soldiers have it in our power to improve very much upon what we have got. What I would urge is that Her Majesty having, by the advice of her responsible Ministers, and with the approval of Parliament, established a new system of army recruitment, it is the duty of every one bearing Her Majesty's commission, and of every enlisted soldier in the ranks, to do his utmost to make that system a success.

In order to prevent any misunderstanding, perhaps I may be allowed (at this point) to say that I, for one, have full faith in the *material* from which the British Army is recruited. I have seldom, if ever, met an English soldier who, when he knew what was wanted, would not do his utmost to carry out the work given him to do. I have never met a body of men in our Army who would not, when fairly treated, respond cheerfully to any order they received.

And as long as all ranks are willing, and as long as intelligence, and courage, and vigour, and energy are not wanting in our ranks, I, for one, will never despair of our having an Army fit to hold its own even against odds. But what I say is that there is want of system, and I think that every one can do something (some of course more, and some less) to infuse more system into their work than exists now, and so to carry out what they have to do with greater ease to themselves, and more benefit to their country.

It need hardly be said that the establishment of a system by which all ranks of an army can be thoroughly trained in time of peace must emanate from the central army government. Perhaps it would not be fitting for me, in a place like this, to attempt to describe at any length how I think this should be done. It will not, however, I think, be out of order to touch upon what a soldier has to learn, and how the

required education can be imparted in regiments and battalions; and this is the task which I have imposed upon myself, and which I will endeavour to carry into effect in as few words as possible.

Instruction, to be worth anything, must be progressive.

A recruit should not be put in the ranks of a company until he has learned how to march in a squad. An Officer should not drill in a battalion until he knows the movements of a company. Similarly troops should not be practised in manœuvres on a big scale until they have been grounded in preliminary work, and know enough drill to enable them to carry out readily any orders that may be given them.

In order to have a system of instruction which shall be of the greatest benefit to all, care must be taken so to arrange the subjects of instruction, and the times and seasons when each particular subject shall be taught to the soldier that the fullest possible advantage may be taken of each month, each day, and each hour that may be available; and that, consequently, the greatest possible readiness shall be attained for peace manœuvres, or for any sudden call to war.

The principle on which the instruction of an army should be conducted, is to divide all men serving with the colours into classes—and it seems to me that three classes are sufficient, viz., the recruit, the partially instructed man, and the trained soldier. Of these the second and third must usually be considered as available for "duties."

Recruits.

An infantry recruit in our Army is usually taught as detailed on Table A (Appendix).

While he is being put through his drills, he is at the same time being instructed in the method of packing valises, and of arranging kits in the barrack rooms; and he is initiated into the system of interior economy in quarters which has been established in the regiment to which he is posted.

If there are opportunities at the station he is put through a course of gymnastics.

The time taken by an infantry recruit of ordinary intelligence in going through his course is from four to six months.

The instruction is carried on either at the depôt, or at the headquarters of a home battalion. The drills are under the Adjutant; the instruction in barrack rooms under the Officers of companies.

A cavalry recruit is taught as detailed on Table B (Appendix).

While at drill he is also taught stable management and the care of horses, according to the system in force in the regiment. He also learns how to arrange harness in stables or camp, and kits in barracks or for parade. He is also instructed in the system of interior economy as practised in the regiment.

The dismounted drills are taught, as a rule, by the Adjutant; the mounted instruction is given by the riding master; and the instruction in barracks by the troop Officers.

It takes a cavalry soldier from nine to twelve months to go through a complete recruit's course as above detailed.

All recruits, cavalry as well as infantry, are sent to school as opportunity offers, until they obtain a 4th class school certificate.

The course of instruction for an artillery recruit, or for one in other branches of the Service, is slightly altered from that of cavalry or infantry to fit him for his special duties.

I do not propose any change in the existing instruction of recruits more than may be rendered necessary by a revision of the text-books, as will be mentioned further on.

Great care should, of course, be taken in the selection of well qualified instructors; and also that everything taught is in harmony with the instruction given later on to the 2nd class soldier. A recruit is more likely to remember what has been thoroughly drilled into him on first joining the Service than any "after-teaching"; and if his first instruction be faulty, it may lead to wrong action and consequent disaster on the field of battle.

The 2nd Class Soldier (or Technical Recruit).

When a soldier has been thoroughly instructed in the recruit's course, as above detailed (the incentive to exertion being explained further on), he should be placed in the 2nd class.

So far in the soldier's career (*i.e.*, while in the 3rd class) the instruction would have been preparatory only; enabling him to take his place in "the regiment or the battalion," and appear on occasional parades; but not, it must never be forgotten, completing his training and rendering him fit for active service. The soldier has, while a recruit, learned the mechanical movements necessary for army organization, for army discipline; but he has not yet been instructed in the *art of war*.

Owing to the exigencies of the Service, the 2nd class soldier (or what may be called the technical recruit) has usually to take his turn at duties and fatigues, and hence more care is required in arranging *his* course of instruction than in the case of the 3rd class man, who is placed unreservedly in the hands of the instructor.

Now, by the Cavalry Regulations, it is ordered that the winter months are to be set apart for instruction by troops under their own Officers. The subjects for instruction are named, and the way in which that instruction is to be given is explained. The early spring months are similarly devoted to detail drill and instruction under the Commanding Officer. Some infantry battalions have a somewhat similar system. But in the cavalry as well as in the infantry there are many causes which interfere with its regularity, and, consequently, some arrangements seem necessary to ensure its observance.

The way, it is thought, to carry it out practically would be to divide each regiment of cavalry and battalion of infantry throughout the Service into, say, four parts: and to let each fourth part (a squadron in the cavalry and two companies in the infantry) be handed over to its own Officers for technical instruction for certain periods at a time. When so handed over, this instructional unit should be made as complete as possible, all duties and fatigues being furnished by the other three. It is difficult to lay down precise rules as to the months

for these instructions. (What would do in England would not be suitable in India.) But a programme might be established which would act as a guide to the course of instruction, and yet be sufficiently elastic to allow of such changes as the requirements of the station in which the troops were quartered rendered necessary.

It is thought that in England during the winter months, from the 1st October to the 31st March, each instructional unit (the squadron or double company) should have a month's technical instruction at a time; but from April to September, when there would usually be more brigade and divisional drills, for only a week at a time, of which three days would probably be all that would be available. Each week throughout the year the Commanding Officer might have one day for battalion (or regimental) exercise; and perhaps once a fortnight in the winter and once a week in the summer there might be brigade instruction. During the winter months the course of instruction will naturally be much interfered with by the weather, and it will be necessary to supplement the out-door teaching by lectures. The annual course of musketry should, as far as possible, form part of the summer instruction (as explained further on).

The subjects of technical instruction for infantry are detailed on Table A (Appendix).

They consist, in fact, of what every soldier requires to know before he is fit to take the field.

Each exercise that required the practice, should, when thoroughly known, be repeated in conjunction with firing with ball cartridge; and this would form the practical instruction of the 2nd class soldier in musketry, and be his annual course.

Commanding Officers on their special days would give instruction in battalion movements under all circumstances, and would teach the men their duty on the line of march.

At brigade and divisional days the private soldier is simply doing what he has learned with his company. But these drills are valuable, as it is only by them that full instruction is given to Officers and non-commissioned officers in the art of directing bodies of men of any size in the movements and operations of war.

The subjects of technical instruction for cavalry are detailed on Table B (Appendix). They consist, for the most part, of what is required to be known in the field. Certain portions should be repeated in conjunction with firing with ball cartridge.

The Commanding Officer's drills (in the cavalry) would comprise the formation and movements of the regiment, duties on the line of march, and the miscellaneous subjects not already enumerated, and which are detailed in the Cavalry Regulations.

Brigade and divisional days test the knowledge already obtained during the work with smaller bodies in the field, and give experience in combined movements with other arms of the Service.

The technical instruction of an artillery or engineer recruit would vary according to what was required to be taught; but the general system could be the same as that explained in the case of cavalry or infantry.

It is difficult to estimate the time that it takes to turn the recruit into the trained soldier. So much depends on weather, and station, and opportunities for instruction. It is not too much to say, however, that few infantry soldiers will be fit to pass from the 2nd to the 1st class, under a year of service, and few cavalry soldiers under two years.

1*st Class Soldier.*

When a recruit has passed in all the instruction above detailed, he may be considered to have served his apprenticeship, and to be fit to be ranked as a 1st class soldier. Unless, however, he has been well brought up in habits of obedience before entering the Service, and is of unusually quick perception, he will not, even in the full time stated, viz., one year for infantry, and two years for cavalry, have learned all that is required to be known by a thoroughly trained soldier; still less will he have acquired those habits of discipline without which no army can withstand for long the wear and tear of war. In order, therefore, that every precaution may be taken against insufficient training, and in order also that the 1st class soldier may not forget what he has already learned, his instruction should continue even after he has been passed into the highest class. All available men of the 1st class should continue the regular courses of technical instruction with those of their company or troop going through for the first time, being, as far as possible, placed in the most difficult and responsible positions. All of them should go through the firing part of the course at all events.

The best of the 1st class men would be noted for promotion to the rank of non-commissioned officer as vacancies occur. All men who aspire to become non-commissioned officers should, in addition to the knowledge above detailed, which has enabled them to pass to the 1st class, be able to command a guard and to take charge of a barrack room. They should also know the simple movements of a company or a battalion if in the infantry; or of a troop, squadron, or regiment if in the cavalry. 1st class soldiers *only* should fill those regimental and staff appointments (such as clerks, storemen, cooks, &c.) of which a certain number are necessary in every army. Those who show any particular aptitude should, when they can be spared, be encouraged to go through one or other of the special courses of instruction which have been established in the English Army, such as signalling, field works, cooking, &c. At foreign stations, those who have shown that they are thoroughly trained to arms should be allowed to learn some trade in the workshops which have been established for the purpose. (This could hardly, it is thought, be done in England, where the battalions, being the training schools, are more constantly occupied than is the case abroad.)

How to carry out the System Indicated.

It may be well to point out how the system which I have proposed can be carried out. For it is sufficiently plain that no system, however carefully elaborated, is any good unless it can be put in force.

First, it is absolutely necessary that the books of instruction shall be full and clear.

Perhaps I may be allowed to express a hope that in the revision of the Infantry Field Exercise Book, which is, I understand, now in progress, the details of instruction may be a little more systematic than has been the case hitherto.

All drill may be divided into two parts, viz.:—first discipline drill, and second, what may perhaps be called practical drill.

Both are important to the proper training of a soldier.

The first, as its name implies, is more or less preliminary to the second. But, in former days, when movements were more rigid and compact than they are now, more of the formations taught as exercises in discipline were adapted to use on the battle-field than is the case now.

Some of the exercises in discipline drill were always preliminary (as, for instance, extension motions, which teach a man how to use his arms; or the goose step which is intended to inculcate regularity of march), but others, such as the march of the line and the column, which are now only applicable to movements preliminary to the actual combat, were in old days actually used for the combat itself; and the result of this change in tactics is that greater pains must be taken now than had to be taken formerly with training, and the soldier must be taught to discriminate between the two drills, and to know what is discipline drill, and what is practical drill.

It is hardly necessary to go into a more lengthened explanation; because the difference between the two drills is pretty well known.

But some one not having much experience with the training of men may say, "What is the use of discipline drill?"

To which I would answer that an army without discipline is no army at all. Discipline means faith in leaders, implicit obedience even in the hour of greatest danger, and consequently courage—the necessity of a successful soldier's existence.

Or again, some one may say, "Why not get your regularity, your obedience, your military faith, by means of practical drill at once?" To this question the best answer is, perhaps, the test of experience. The same care, the same gradual process, is required to be used in training a soldier's body to powers of endurance, and his mind to habits of obedience, as is necessary to get a colt into condition, and render it docile to any movement of the rider's hand.

The greatest possible stress has been laid by every thinking leader of men in modern Europe on the fact that, in proportion to the greater use made of loose formations, is the necessity to train troops more carefully to habits of discipline, and to keep them as long as possible in compact formations, where the bonds of discipline are the most easily preserved.

It is thought that the Book of Regulations for the instruction of the infantry soldier should be divided as follows:—

Part I. *The School of the Recruit*, which should include all preparatory exercises, without and with arms, and all movements necessary to be known by an individual. The whole of the instruction

should be conducted in the spirit of a discipline exercise, so that knowledge of certain necessary movements and exercises may be combined with a training of mind as well as body.

Part II. *The School of the 2nd Class Soldier.*—This should teach all movements required in the company, whether on the march, in the fight, or at the bivouac. It should, in fact, be the *Training School for War.*

It should include the drilling of a company as a compact body; and also all field movements, such as outposts, field-guards, the formation of bivouacs, the arrangements for attack and defence, &c.

These movements should be practised at first without firing, and afterwards, as far as practicable, with ball cartridge (as the annual musketry course of the 2nd class soldier).

Part III. *Instruction in the Battalion.*—This would comprise battalion drill as applicable to the march, and to reserve formations on the battle-field; and it would include field movements, such as attack and defence, bivouacs, marching in an enemy's country, skirmishing, outposts, &c.

Part IV. *The School of the Brigade or larger Bodies.*—This, like other parts, would be divided into (1) drill proper and (2) field movements, including tactics.

Part V. *Miscellaneous* (as usual), which would include—

a. Inspections or reviews.
b. Regulations for training.
c. Guard mounting in time of peace.
d. Presentation of colours.
e. Funerals.
f. Bugle sounds.
g. Duties on the march in time of peace.
h. Transport by railway.
j. Embarkations and disembarkations.
k. The formations of camps.
l. Dress and equipment.
m. Shelter-trench exercise.
o. Rules for crossing temporary bridges.

Secondly. All Officers should have a thorough knowledge of what may be required to be carried out at any time—in peace or war—by the rank they hold.

The necessary knowledge can be acquired partly at training schools, partly at military colleges, and partly after joining the Service. No Officer should be dismissed drills until he knows all that has already been detailed as requisite for the instruction of a trained soldier.

The incentives to exertion in the case of Officers will be the sense of honour that exists among English gentlemen, the feeling of duty to Queen and country, and the natural and perfectly legitimate wish to qualify for promotion, and so get on in the Service. Their fitness for promotion will be discovered by the existing examinations, and by a practical test in the field at every half-yearly inspection by General Officers.

Now, the technical training of the men would, under the system

indicated, be conducted in squadrons and double companies by the troop and company Officers; and in regiments and battalions by Commanding Officers. And, as nothing tends so much to give real knowledge of a subject as to have to teach it to others, in teaching his men every Officer, from the lowest to the highest, will really be improving his own military knowledge, and step by step rendering himself fit for higher commands.

Thirdly. Each non-commissioned officer and private must be taught all that may be required of him in the field, so that no link in the chain may be so weak as to break at the hour of need.

The knowledge necessary to make an efficient soldier can never be acquired wholly from books. It must be learned partly, no doubt, by theory, but partly also by actual practice in time of war, or at all events by very careful training in the field under circumstances as nearly akin to war as possible.

The incentives to exertion in the case of the majority of the men (*i.e.*, those who have little or no chance of winning a commission) will be the prospect of increased indulgences to trained soldiers and non-commissioned officers. (I should like also to see different rates of pay established for the different classes, as in the Royal Navy; but the matter of pay is not an absolute essential to the scheme I have propounded, although no doubt it would be a great help towards it.)

Thus a recruit should not be overworked, because so doing only disgusts him with the Service, and tempts him to desert; but his time should be fully occupied to keep him out of mischief. No leave should be granted to him, unless under special circumstances, until he has passed his drills. (His pay should not, it is thought, be so high as it is at present, considering that he does nothing for it. It should not be overlooked that in civil life it is usual for a young man to pay to be taught a trade.)

Directly, however, the recruit passes to the 2nd class, and does duty with his regiment, he should be allowed such short leave as will not interfere with his course of technical instruction (and it is thought that his pay should be raised to what a soldier's pay is now).

As soon as the soldier passes to the 1st class, furloughs to a limited extent should be granted to him; and passes should be given to a later hour than to the other classes. (His pay should be again raised, and his first badge should be given him, provided his conduct had been good so far.) To 1st class men only should "appointments" be open, as well as the permission to attend special classes; and to these only should the way be open to promotion to the rank of non-commissioned officer.

Fourthly. The regularity of the system of instruction which has been suggested must be maintained by the character of the inspections, and also by keeping up a certain number of forms.

I am not an advocate for increasing returns, and would, if I could, reduce them to a minimum. But a certain number are necessary to the establishment of any system, as all instructors as well as inspectors know well.

Three forms per annum would probably be sufficient for the system

above detailed. These forms should be under the supervision of the Commanding Officer, and should be produced at the periodical inspection of regiments. They would be—

1. A diary for the year, showing the proposed courses for instruction and the months in which each troop or company would be handed over to its own Officers for technical teaching. The scheme for the year should be detailed on one side of the diary (approximately by months or perhaps weeks), and the actual work done should be written down on the other side, day by day, as the year progressed.

2. A return, similar to a musketry one, of the course of instruction of each squad of recruits, under the Adjutant.

3. And a return, similar to a musketry one, of the course of technical instruction given in each squadron and double company under the troop and company Officers.

All the returns should be guarded for a certain time with the regimental records, as references; and those of the current year should be produced at Generals' inspections.

It would probably be useful, in connection with the time table of drills, &c., to establish two or more extra drills per week, to which backward or inattentive men from any of the courses of instruction could be sent. The most convenient time for these would probably be the late afternoon or evening on those days when the majority of the men had a half-holiday. (These drills, it need hardly be said, should be distinct from punishment drills.)

Fifthly. The completion of a course of training would be effected by means of summer drills and manœuvres. It need hardly be said that none but troops who have gone through a course such as I have described should be used at these exercises. For such troops they are useful, inasmuch as they afford means of practising with large bodies what has been learned with small ones, and of teaching men (as far as can be done in time of peace) the lessons of war.

Conclusion.

Now, some Officers tell me they already have the system which I have described, or one practically the same, in their regiments; but they say that they are so interfered with by circumstances over which they have no control that they are unable to carry it out fully.

I know that in every one of those regiments that have in past times brought credit to the British arms there must have been once a good system which taught discipline and ensured considerable experience in field movements. Perhaps in some the system exists still.

But what I want is that every regiment in the Service at present without it shall have such a system; and that those which have it now, in a more or less dormant state, shall be encouraged in every possible way to keep it up.

It must be remembered that with England's extensive Empire and responsibilities no one can tell where a war may break out; no one can divine which battalion will have to bear the first brunt of the fight; and, therefore, every battalion should be ready for immediate service.

I have already said that I have faith in the stuff of which the British

Army is composed. I will add to that my conviction that it is quite possible to elaborate a system by which that Army can be properly trained; nay, more, that by some such system as the one sketched out the work could be done with greater ease and more pleasure to all than is the case now. With greater ease, because everyone would know exactly what he had to do and when he had to do it; and with more pleasure because everyone would have a responsibility, an occupation which is, I venture to say, not only one of the most honourable, but one of the most interesting (when properly taken up) of any calling in the world, viz., the training of men.

I have already given an outline of the system I propose; but I must support my assertion of the practicability of carrying it out by a few statistics. (I will take the infantry as an example.)

There are, by present arrangements, several establishments for infantry battalions in the British Army, varying from 950 to 480 rank and file.

We need only consider the weakest establishment, because that is naturally the most difficult one in which to carry out any regular system.

I have inspected "the states" of a good many battalions. The weakest one on my list had 38 sergeants, 17 drummers, and 469 rank and file. Of these 98 were recruits, which would be drilled in "squads" as they arrived; their instruction being carried out as quickly as possible in order to enable them to be passed into the 2nd class, and take their turn of duties. This leaves us a balance of 371 rank and file, to which to apply the proposed system of technical training.

Now out of this number there were on the day on which I took my return only 29 "on parade," but there were 30 at the gymnasium, making a total of 59 available for instruction. And there were on special employment—such as signallers, servants, tailors, and shoemakers—and on leave 94; of these a quarter could be taken without any unnecessary disturbance.

Again, there were on garrison and regimental employ 48, and on guards and fatigues 42, which could very easily be reduced by at least one-sixth.

We have then—

	Rank and File.
On parade	59
One-fourth of specially employed men, or $\frac{94}{4}$	23
One-sixth of men on garrison and regular employ, or $\frac{48}{6}$	8
One-sixth of guards and fatigues, or $\frac{42}{6}$	7
	97

Now, if we multiply our total by 4 we have $97 \times 4 = 388$, or actually more than are required to keep our whole battalion (which I have just stated was 371 without recruits) constantly in a state of training.

But it may be assumed that there will sometimes be more recruits to drill than were present with the battalion of which I have given the statistics. Let us take four squads of 12 and four of 24 recruits

as the number that might be required to be drilled in a battalion (or a total of 144), and let us put our assumed battalion at the minimum authorized strength, namely, 483 rank and file; and we see that by taking 84 men at a time for technical instruction we are still able to train the whole battalion, for we have—

Recruits	144
4 bodies of 84 (2nd and 1st class men).....	336
Total established strength	480

But even under more disadvantageous circumstances than the existing ones, or than the assumed ones, the system proposed could be carried out with ease.

For it must be borne in mind, large numbers are not required for technical instruction—on the contrary, the fewer there are, the easier it will be for the instructor to give his lesson, so that all may profit by it. And when there are many it will occasionally be necessary to divide into two or more bodies, in order to reap the fullest possible advantage of the time available for instruction.

Let me briefly run through what I have said. At the commencement of this paper I gave a short account of the great advantages resulting from a good system of training in one or two notable instances in past times. I then attempted to show that a want of proper training for war was one of the principal causes of the disasters that have befallen English troops in our recent campaigns, and I proceeded to consider how under the present organization any improvement could be made.

Having explained how the general principle of all instruction is to divide those who have to be taught into classes, I suggested a division into three, which, commencing from the bottom, would be the recruit, the 2nd class soldier, and the 1st class soldier.

I then discussed the kind of instruction to be given in each class. And, lastly, I attempted to show how the system I advocated could be carried out.

The subject may be to some a dry one, but it is (as I have before said) one of the most important that can occupy the attention of a military man.

For what is the use of all your soldiers if they don't know how to fight? What is the use of all your arms if men don't know how to use them with the best effect? What is the use of any number of reserves if men are passed into them improperly trained?

The subject, moreover, is one that concerns, not only the regular soldier, but every member of the Auxiliary Forces, every Officer who has left the ranks for a while, but stands ready at his country's call to aid her in the hour of peril. Nay, more, it concerns every faithful subject of the Queen throughout her dominions, inasmuch as troops insufficiently trained are a broken reed on which to lean, a source of danger, a sure cause of disgrace to whoever has to trust in them.

Should any apology be needed for bringing forward our recent defeats, for making them, as it were, the keystone on which my argu-

ment is built, I would remark that I can conceive no better use being made of them than as *beacons* on our nation's future path. If only those beacons can be made sufficiently prominent to cause us to look to our old ship; to see that her planks are sound, her sails in order, and her crew on the alert; so that when the next storm comes, she may weather the breeze without any dangerous scratch from the rocks that surround her: the blood of those who fell at Maiwand and Isandlwana, and on the slopes of the Drakensberg Mountains, will not have been shed in vain.

APPENDICES.

APPENDIX A.

SUBJECTS OF INSTRUCTION FOR AN INFANTRY SOLDIER (ACCORDING TO THE PRESENT TEXT-BOOKS, 1881).

(1.) *School of the Recruit* (4 to 6 months).

1. Recruit or squad drill. (As detailed in the Infantry Field Exercises.)
2. Rifle drill. (As detailed in the Rifle Exercise.)
3. Company drill (as detailed in the Field Exercises), including extended order, and the explanation of the difference between skirmishing and advancing to the attack.
4. Duties of guards and funeral parties. (Infantry Field Exercises.)
5. Recruit musketry instruction. (Musketry Instruction.)
6. Packing kit, wearing dress and equipment, interior economy in quarters, &c.
7. Gymnastics (if there is opportunity).

(2.) *School of the 2nd Class Soldier (or technical Recruit)* (6 to 12 months).

1. Recapitulation of portions of company drill (Infantry Field Exercises), explaining *the principles* and *the meaning* of each movement, especially in extended order.
2. [1] Advanced and rear guards. (Infantry Field Exercises.)
3. Camp guards and outposts.
4. The formation of camps and bivouacs. (Regulations for Encampments.)
5. Shelter-trench and shelter-pit exercise. (Infantry Field Exercises.)
6. [1] The attack and defence of positions and villages.
7. Escort duty, &c.

(3.) *School of the 1st Class Soldier.*

1. Repetition of the instruction of the 2nd class soldier.
2. Command of a guard. (Infantry Field Exercises and Queen's Regulations.)
3. Charge of a barrack room. (Infantry Field Exercises and Queen's Regulations.)
4. Movements of a company. (Field Exercises.)
5. Theoretical instruction in minor tactics (when practicable).
6. Special courses, viz., *signalling*, *field works*, *cooking*, &c. (when they can be spared).

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[1] N.B.—Portions to be repeated in conjunction with firing with ball cartridge.

APPENDIX B.

SUBJECTS OF INSTRUCTION FOR A CAVALRY SOLDIER (ACCORDING TO THE PRESENT TEXT-BOOKS, 1881).

(1.) *School of the Recruit* (9 to 12 months).

1. Squad drill on foot. (Regulations for Cavalry.)
2. Military equitation, including saddling, bridling, mounting and dismounting, &c., and the single ride. (Regulations for Cavalry.)
3. Instruction with the arms carried by the regiment (as detailed in the Cavalry Carbine, Sword, and Lance Exercise, or in Infantry Rifle Exercises).
4. Troop drill on foot. (Cavalry Regulations.)
5. Instruction of the troop and squadron mounted. (Cavalry Regulations.)
6. Duties of guards, and funeral parties, escorts, &c. (Cavalry Regulations.)
7. Stable management and care of horses, arrangements of harness, &c., in stables, and kits in Barracks, &c.

(2.) *School of the 2nd Class Soldier (or technical Recruit)* (9 to 12 months).

1. Further practice in riding; the double ride. (Cavalry Regulations.)
2. [1] Skirmishing. (Cavalry Regulations.)
3. [1] Advanced and rear guards and flanking parties. (Cavalry Regulations.)
4. [1] Escorts for stores, &c. (Cavalry Regulations.)
5. Formation of camp and bivouac. (Instructions for Encampments.)
6. Outposts. (Cavalry Regulations.)

(3.) *School of the 1st Class Soldier.*

1. Repetition of the instruction for the 2nd class soldier.
2. Command of a guard. (Cavalry Regulations and Queen's Regulations.)
3. Charge of a barrack room. (Cavalry Regulations and Queen's Regulations.)
4. Movements of a troop or squadron. (Cavalry Regulations.)
5. Theoretical instruction in minor tactics (when practicable).
6. Special courses, viz., *signalling, field fortification,* or *pioneering, cooking,* &c. (when available).

The CHAIRMAN: Gentlemen, Colonel Harrison said that some of us might think this a dry subject, but I certainly do not think that any soldier of experience will think it a dry subject. Some of our younger friends present may have thought parts of the subject a little dry, but we must all have been struck by the elegant peroration to which we have just listened; and I am sure we must all have been convinced how important the subject is to the Army and the country at large. I see a great many very experienced Officers present, and I hope we shall have a good discussion. I would particularly wish to invite Officers commanding regiments and Officers who have lately commanded regiments, who, no doubt, feel the pinch of the shoe more than others.

General W. C. NAPIER: The system of training of which the lecturer has given us an outline involves questions, not only of theory, but also of practice. These systems are sometimes very nicely drawn up on paper, but they do not always succeed in practice. I do not mean to say that this one may not; let it be tried by all means. The reason why I venture to address a few words to this meeting is because I think the lecturer has dwelt too much upon what he has called our "series of disasters" in our late wars. We have met with misfortunes—what army does not meet with misfortunes? but I think to call them "disasters," and to propose to establish a new system of training troops in consequence of these few "disasters," is rather a mistake. Besides, though we have met with "disasters,"

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[1] N.B.—Portions to be repeated in conjunction with firing with ball cartridge.

as you may call them, we have also had victories gained by the same troops in Afghanistan and elsewhere. These troops were all trained, I presume, under the same system that the troops which met with the "disasters" were trained under; and, therefore, if we are to base any arguments and considerations upon these "disasters," let us also give our military system the credit of the victories that have been gained by the same system, with the same troops, and under the same Officers. I do not think sufficient cause has been shown in our recent military history for us to make any radical difference in our training. Our training may be improved; I do not know whether that is so or not. I have not had sufficient practical knowledge of the subject myself; but I presume the system is much the same as it has been for many years; and under that system we have for the last fifty years, since the Peninsular War, gained very many and very considerable victories in all parts of the world. I do not think, therefore, that the few misfortunes we have met with should make us seriously consider any very radical alteration in our training. There may be difficulties connected with the training of our soldiers in consequence of the continual introduction of recruits; our Army now consists chiefly of recruits; but that is not our fault, it is not the fault of the Officers; and the Officers, I presume, do their best to train the men, just as they always did. I apologize for having made these observations, but really I felt that too much stress was laid upon these little misfortunes we have met with.

Colonel CLIVE, Commanding Grenadier Guards: With reference to what General Napier has said, I did not understand Colonel Harrison to lay so much stress upon these disasters, or reverses, as I prefer to call them, but rather that, inasmuch as there had been certain reverses in the course of the last two or three years, it might perhaps be expedient, in a professional hall of this kind, to make them the excuse for inquiring into the training of our troops, with a view to seeing if they were put upon fair terms when contending with other troops. The question Colonel Harrison wishes to raise is, whether when we send our troops to fight in Asia, in Zululand, in Africa, or on the Continent, we give them the best chance possible? I agree entirely with him that we do not do so. I think that, owing to the ignorance of the classes whence we draw our recruits, we have an up-hill game to play. In other European countries the Army is manned by recruits taken from all classes; some of very superior education, some very well and some moderately educated, but all, probably, better educated than Thomas Atkins, when he comes from the tail of the plough, or from Glasgow or Manchester, or any of the great recruiting stations, whence he enlists as a last resort because he is hungry. Thus we get a bad start, and it is for that reason that it is more incumbent upon us to do whatever we can to drive into the minds of our soldiers that which is necessary for them if they wish to be successful in war. One point which bears upon this question is the shortening of the time during which we are allowed to keep soldiers with the colours. I hold that we may go too far in that direction. It is no answer to say that because you can train a German soldier in two and a half years to step into the field and win actions which are now notorious that, therefore, our soldiers are able to do the same thing. Our men have not the same education to start with, though I believe we have a good fighting material. If it takes the German soldier two and a half years before he is thoroughly efficient in the knowledge of his art, it will take our own soldier four years to arrive at the same point of efficiency; and if we keep our soldiers six years in the ranks, I think that is the very shortest time; and then only for the last two years would they be at what is called their best for purposes of fighting. I hope this point—duration of service—will be considered here, when Officers give their experience as to the best means of teaching men to become fighting soldiers.

General HIGGINSON, Commanding Home District: I wish some young Colonel of a regiment would be kind enough to give us his views upon this extremely interesting subject. I am sure Sir Lumley Graham will excuse me for saying, as a General Officer having a certain number of regiments under his command, that it would be very encouraging to know what the younger Commanding Officers think on the one or two points mentioned by Colonel Harrison; more especially that of keeping the men off duty during a certain number of months in the year; and also whether they are absolutely satisfied that they have a standard of excellence up to which to train the

men; and that they absolutely understand the point where grammar should cease, and where the more important mental training should begin. If some young Commanding Officer would be kind enough to give us a word or two upon that subject I think we shall be grateful.

Colonel LONSDALE HALE: As no one will tread upon the tail of Colonel Harrison's coat, perhaps they will tread upon mine. As Commanding Officers do not seem inclined to discuss this subject, and I want to promote discussion, I say deliberately here, before Commanding Officers, and I say it with all due respect to General Napier, that there is not existing a proper system of training for the British Officer; and also that Commanding Officers do not train their Officers and men up to the standard required by modern warfare; but I do not for one moment say it is their fault; I say, moreover, that, with certain exceptions, the younger Officers of the British Army are creditably dissatisfied with their present position.[1] I happen to mix with the younger Officers very much, and I can confidently affirm that they desire this training, they are asking for it; and at present, and I say it to those Commanding Officers who won't rise on this occasion, the Commanding Officers do not give it them. It is also quite practicable for the Commanding Officers to give their Officers a good training in field manœuvring—not the most perfect training—but at the same time a very fair training, and something far better than they have at present, and I repeat that that training will be gladly accepted by a very large number of the British regimental Officers. We shall have to provide, it is true, for certain special cases, one of which occurs to me at the present moment, having been brought to my notice about a fortnight ago. I was talking on this subject to a very ardent young soldier, belonging to a certain class of regiment—I won't say what class—and he remarked: "Well, Colonel, in any system which you may devise for "these regiments, you must bear in mind two important points, which are a *sine qud* "*non* with them in the first place, there must not be an atom of work after one "o'clock in the day; and in the next they must have, as a right, leave for every race "meeting within twenty miles round." Well, I own, Sir, at first I felt what is vulgarly called "stumped;" I did not know how to get over this little difficulty; but, after all, on consideration it disappeared, like all these difficulties; and I came to recognize the fact that the demand of these young Officers is merely one form of the "early closing" movement; and that when we give them the "early closing" movement they must give us something in return, namely, the "early opening" movement, at the other end. We have merely to adopt the system which I have seen myself in my visits to Metz—the same system which led us, when we wanted to see infantry at their field musketry practice, to turn out of our hotel at three o'clock in the morning, and which caused a young German Officer who was dining with us one night to apologize for going to bed at half-past eleven, because he had to get up at six o'clock in the morning to drill a squadron for two hours. I am not prepared to go as minutely as Colonel Harrison did into the details with reference to the instruction for the men, for, with all due deference to him, I do not think that he or I possess the experience or knowledge requisite to lay down any fixed rules. These rules are only to be determined and laid down by Officers who have had practical experience in command of regiments and battalions, and in the difficulties which surround the subject; but, still, there are one or two principles which might very well be followed, and which it is not presumptuous to suggest. Why should there not be given a programme of instructions to the Commanding Officer of every battalion? but why should we insist upon that programme of instructions being uniformly carried out? Why should the Commanding Officer of a battalion of 450 men be expected to produce the same results at the end of the year as a commander of 950 men? Why should the commander who is favourably situated with regard to ground over which to work be expected to produce no more than the man who is situated perhaps in a garrison town, and cannot find the ground to work over? Why should you expect the Commanding Officer who has constant drafts on his battalion to produce the same work as a man who is not

[1] The Field Officers also want to learn. At one station twenty have voluntarily placed themselves under the Garrison Instructor.

under these difficulties? What we might do is, having given this programme to the Commanding Officers, to say, "There is your programme for the year, and we "expect you honestly and really to do the best you can with that programme. We "call upon you, first of all, to help yourselves; to diminish your employed men, to "diminish your regimental guards, to diminish your regimental fatigues; and we "will also direct that the garrison commanders shall diminish their demands for "garrison fatigues. We will speak very severely on the subject to the Commanding "Royal Engineer; they shall not take your men for their work; and then you shall "have the men entirely to yourselves for nine months in the year; and neither the Bri-"gadier nor the District or Division Commander shall come near you for those nine "months. You shall have no inspections by distinguished personages; no royal "reviews; but we will concentrate all those higher branches of work into the remain-"ing three months; and at the end of the nine months we expect you to give the "best result attainable under the circumstances." Now, one word with regard to the effect which this new system of training Officers and men would have upon British Officers, because at the present time there is a perfect scare upon the subject. The unfortunate British Officer sees himself with no leave, and with all sorts of horrible things before him. How the British Officer will take this greater occupation of his time depends upon what the nature of that occupation is. If we are going to turn the British Officer into the British drill sergeant I am afraid the effect will be very bad indeed; I cannot imagine that any alteration of that kind would be entertained for a moment. It is not usual to use your razor for cutting your small boy's slate pencil, for you destroy the comfort of your own shaving by doing so. You preserve the razor for your own beard and whiskers; giving the boy a sixpenny clasp knife to cut his pencil with. Now I would propose to do that still—to use the sixpenny clasp knife to cut the pencil, reserving the razor for the whiskers; and leaving the Officer to make use of the pencil when it is properly cut. With regard to the Officers themselves, no doubt the result will be that a certain number of men will leave the Service. Those men who merely come into it from no love to the Service will go at once. We shall lose also a certain number of military enthusiasts, those men whose ardour for joining a military course cannot be quenched; whether it be for signalling, field works, cooking, or photography, they are always going after these courses. You think they are really very fond of their profession indeed, but the fact is their love for these courses depends upon the distance from Ireland, and the proximity to London, at which they are carried out. Those gentlemen, who may be all included under the common name of "Skrim Shankers," will go, and will be a very good riddance of very bad rubbish. We shall lose another class of Officers who are chiefly in the mounted Service and in the aristocratic battalions—men of wealth and property, who came into the Service because they had the instincts of soldiers, but who have had other opportunities for employing their time, other calls upon it. They are perfectly content to go through the drudgery of peace service so long as their time is not too much occupied; but when we come to ask them to occupy all their time with their work then they very naturally say "No." I am afraid a great many of them will go. They will take away some of the best sportsmen, some of the best riders, some of the best fellows in the Service, and we shall regret their departure. By those who remain the new system will be accepted (?) cheerfully. I warn them beforehand it will have its dark side. I am now quaffing the cream of teaching. Any man who is a Professor of the Staff College and does not like it must be a most discontented individual. But before I was allowed to do that I had to take large draughts of "sky blue." And if it was only known what it is to teach stupid boys the same thing over and over again, the British Officer would not perhaps profess himself to be quite so anxious to teach his men as he does now. The men whom I most pity are the Commanding Officers of battalions and regiments. I tell them they have a very hard time before them. To hear some of them talk they seem to think it is an easy thing to teach the Officer of the present day, and the non-commissioned officer and private. They think of the British Officer as he was when they and I entered the Service thirty years ago. I have no hesitation in saying that the British Captain and subaltern of to-day knows theoretically quite as much as the British Colonel did when we entered the Service. What the Officers want now is not to have bits of "Clery on Minor

"Tactics" thrown at them: they want the application of these things; and Commanding Officers will find they have their work cut out for them, and it will occupy pretty nearly all their time to do it satisfactorily. The result of the new system of training introduced into our Service will be to produce a set of men worthy of the title I, for one, aspire to, namely, professional soldiers; but they will lose not one single attribute, nor one single fine quality which has hitherto distinguished the British Officer and gentleman. I regret I omitted to touch, as I had intended to do, on the absence of any system of training of our Staff Officers. At the Staff College we train men for the Staff, but as Staff Officers they have no training whatever subsequently.

Captain LUMLEY: May I be allowed to address a few words to you, especially as I have served in an army where a similar system to that which the lecturer has laid before us is the custom? I have seen the practical working of what he proposes, and therefore speak from experience of what we have heard him lay down as a principle to be adopted in the British Army. From my experience I do not think that it would in any way diminish the ardour, zeal, or the social position of the British Officer to be obliged to work; on the contrary, the more he has to do the more pride he will eventually have in his profession, for he would strive with his comrades to produce better men, and more efficient companies and squadrons than theirs, knowing that he would be judged by what he produced. A very distinguished Officer said just now "he did not think that any new system was "wanted in the English Army, because the present one had done very well before." The English Army has done very well indeed, it has won a great many glorious victories; but it must be remembered that the profession of arms, like every other profession or science, is progressive, and what was good then, like machinery of forty years ago, is obsolete now, for battles were fought in former days on quite a different basis and with other tactics. If the English Army prefers to remain conservative—I am not speaking from a political point of view—it will find that it must meet enemies who have progressed, and therefore must not be astonished if it cannot cope successfully with them. The system which the lecturer has proposed requires, I think, to be successful, proper organization of the troops before it can be adopted. If you had an independent uniformity of instruction in companies and squadrons which should be entirely left to the initiative and control of the Captains, you would find the system much easier to work and more likely to bear good results. As far as I have seen, and I have had some little experience with the English Army—having kept my eyes open while I have been in England, and while I served with them in the field—there is a great deal of unnecessary interference with the Captains—in point of fact, they have no power whatsoever; but if the restrictions now placed upon them were removed and more authority allotted to them, they would be able to drill and instruct their companies according to their own ideas, and their efficiency would be tested by their productions. Colonel Harrison pointed out that very few men could be brought on parade. Now, if the Captain were responsible for the efficiency and the training of his company or squadron, he would avoid all useless fatigues and always assemble his men at hours when he knows that the greatest number could be present. I think it would be very desirable that a system similar to that which Colonel Harrison has advised should be adopted, and that special periods should be mapped down for the different stages of training. I am not prepared to say how long should be devoted to this work in the British Service, but in Germany a recruit is one for a year. He joins during the winter period, begins his drills at about eight o'clock, and goes on until eleven; those are what you call manual drills, and setting up, such as lance, carbine, musketry, marching, and so forth. After which the man goes and rests for a couple of hours and comes out again at two o'clock, when he has vaulting, gymnastics, and theoretical instruction till five o'clock. These theoretical instructions are to teach him what he is going to learn at a future period of the year. You begin by teaching his duty, instilling into him the principles of discipline, and he is taught theoretically what he is afterwards to do practically. This goes on during the winter months; in a like manner the summer and autumn drills and manœuvres are carried on, the men being always instructed by the Officers. I do not see that there is any reason why English Officers should not be able to perform the duties which are carried out by their comrades in

the German Army, and who it must not be forgotten are of the same social standing as themselves, although it is often said that if the English Officers had to work in the same way as German Officers, gentlemen would not enter the Army. This is not my opinion.

The CHAIRMAN: Will you allow me to suggest, Captain Lumley, that the lecture is on "The Training of the English Army." There is a great deal, of course, very valuable to be learned from the German Army, but we have already had an interesting account of it in this Institution from yourself very lately; and I think that we cannot afford time to hear any more about it now. I do not wish to stop you, but only to recall you to the subject now under discussion.

Colonel MONCRIEFF, Commanding Scots Guards: As one of those Commanding Officers who have been rather reproached for being so backward, I must say that I wish I had stood up before, because Colonel Hale's eloquent speech has anticipated all I can possibly say on the subject. Speaking from experience, what I certainly do feel, and have felt for some time past, is the want of some organization and system laid down, so that the whole responsibilities of training should not rest with the Officer commanding the battalion or the regiment, but with the higher powers. I joined the Army in 1854, but it was some ten years afterwards before I had the chance of being on outpost duty. That was a misfortune, but soldiers in London have not much opportunity of doing such work. At Aldershot I have been on outpost duty; but there the whole battalion went out together, and the Colonel had barely ridden round the sentries when it was time for the battalion to go back to camp. The winter before last, having my battalion at Windsor, I did carry out a system of taking one company at a time: I sent them over different parts of the country with a "general idea" for the Officer in command, and then I afterwards rode out myself to see how the outpost work or reconnaissance had been carried out. I think in that way practical work was done, and my second battalion, now at Windsor, is working on the same plan. But these matters are not properly systematized for us. I perfectly agree with what Colonel Hale has said, that the sooner we have some definite scheme laid down and authorized, as Colonel Harrison suggests, the better it will be for the British Army.

The CHAIRMAN: We have heard several infantry Officers speak on the subject; perhaps a cavalry Commanding Officer will give us his views.

Lieut.-Colonel D. MILNE HOME, Royal Horse Guards, M.P.: I confess I feel peculiarly diffident in saying a single word; but as the first duty of a soldier is to obey, I consider my duty, Sir, is to obey you now. At the same time my diffidence is increased for two reasons: one is, that I have not the experience of many gentlemen present, and another is, I am not the Commanding Officer of my regiment, although I happen to be in temporary command just now. But perhaps I may be permitted to say, following up the excellent lecture to which we have all listened with great interest, that we have at Windsor been carrying out, as far as we could, the very programme that has been laid down by Colonel Harrison, although not perhaps in full detail. We are going on with the winter duties of which he spoke at the present time, taking off duty for a week or a day those squadrons which are practising these details of drill, such as outpost and "screening duties," as they are laid down in Bell's book. I would like to allude for one moment to a remark which fell from a gallant Officer with reference to a class of Officers in the Army, some of whom he spoke of as being men of wealth and property, who would be averse to undertaking the more arduous duties of instruction which we are all called upon to perform now to a greater extent than we were when I was a Cornet. I do not wish to speak in any egotistical spirit, but in my regiment there happen to be several of these gentlemen who are blessed with means and property who have other than regimental calls to duty, and I may say that they every one of them show a desire to learn their duty and never flinch for one moment when their Commanding Officer calls upon them to go out with their squadrons or troops to any of those instructive field days which we have been enjoying during this last autumn and winter. I shall be glad, like Colonel Moncrieff, to see a regular system inaugurated throughout the Army. It is all very well for *us* to do what *we* think is right, but another regiment may not carry on a similar course to ours, and then when we are thrown together the mimic battle may not go off so successfully as it might do, and therefore I would

venture, with all respect, as a member of this Institution, to suggest that these alterations in our drill should come from head-quarters.

Sir THOMAS DYKE ACLAND, Bart., M.P.: I know how strong is the modesty of British Officers, and therefore I can hardly put into words the embarrassment which I feel in rising in a room like this. But I have received much kindness here. I am a civilian, a retired volunteer and yeoman, and belong at present only to a talking body, and not to a fighting body; but, nevertheless, I am one of those who do take an interest in the noble Services so well represented in this room. I would not presume to say a word about the lecture beyond one of admiration, and thanks to the lecturer, and to almost everyone who has spoken upon it. But there is one subject which I think the Colonel on my right touched upon, and, if I understood him correctly, I venture with all respect to dissent from. He says that you cannot make the British Officer the teacher of his company, or squadron, or troop, and that it should be left to the sergeant to do it. Now I speak from the limited experience of a civilian, and I can only say that a long experience has taught me that the drill sergeants of the English Army do not, as a general rule, know how to teach, although they know how to fight. We do not find that they can teach us or our men as we have to be taught in the very short time we Yeomanry, or Volunteers, or Mounted Rifles have to learn our business. I do earnestly hope that some appeal on this subject may rise from the Officers of the English Army to the higher authorities. It is found necessary to provide proper training for some 15,000 schoolmasters who are to teach elementary schools, and something of the same sort should be done for the drill sergeant, that is, he should have a normal school or a training school in which he may be taught how to teach. And I do not limit that observation to the drill sergeant; I would go a step higher, and include all instructors of the soldier. I do not know whether we are to go on for ever in the English Army with the system of the Adjutant and drill instructor preparing everybody for drill, or whether we have nothing to learn from Germany; but this I do say, as a retired Officer of both Yeomanry and Rifles, that we are not capable, in the short time that we have, to do our work unless the Army will give us better teachers. And permit me to say to you and your grand profession that you are approximating, in a certain sense, to the difficulty felt by the auxiliary forces—you have very much less time to do your work, and you have a great deal more work to do. I mean that there is much more required in the present day of the soldier and the Officer, and with short service there is less time to do it in. Therefore, I do humbly thank the gallant Officer who has spoken so plainly and so manfully as he has to-day. May I venture to repeat a remark that was made to me, because I do not presume to express opinions of my own on purely military questions? A very good Artillery Officer told me the other day that until the system of inspection by General Officers was altered in the English Army, we should never get young Officers encouraged in practical training of troops, that it is not a mere question of grooming horses or polishing brasses. We saw the other day the statement of a Continental inspecting Officer who said, "Well, Colonel, your horses are looking very fat indeed "on half rations of work." Now I am told that many Officers feel they have not a chance of bringing up their younger men to the practical use of the arms which they have to manage. There is too much time given to outside show; I know that this is a civilian point of view, and I do not press it. Let me offer one other little bit of experience; I have frequently found that amongst those gallant professional Officers by whom I have had the benefit of being assisted in my duties, there has been always a dislike of practical training before an inspection. "Don't unsteady "the men, they will not look so well on inspection day if you do." Now I venture to say, whoever it may be who attempts to learn military work, he will never know what he knows until he has found out what he does not know by being put to the test; and it appears to me in all our auxiliary forces, while we do our best to learn drill, Officers and men ought to be put to the test by being told to do something perhaps rather unexpected, and then seeing what sort of blunders they make. Does not that also apply, to a certain extent, to the training of the Army? and in that I will only repeat what two or three Officers have already said, that the young English Officer not only has more to do, but he wants more opportunities of being brought to the test of practical work.

Lieut. E. G. Edwards, R.H.A.: As the commander of a division of 2 guns, 40 horses, and 60 non-commissioned officers and men of the Royal Horse Artillery, I venture to offer a few remarks upon the system of training I should advocate for myself and them. The subjects to be taught are—(1) Marching drill and gymnastics; (2) stable and barrack duties; (3) riding and driving; (4) gun drill and gunnery; (5) sword and carbine drill, range-finding, &c.; and, lastly, in the case of ill-educated men, (6) the A B C and "three R's" until a 4th class certificate of education can be obtained. It seems to me that the proper persons to teach these subjects to my division are (or ought to be) myself, my two sergeants of subdivisions, my half-dozen rank and file non-commissioned officers, and any particularly intelligent man who might appear qualified to impart his knowledge of goose step or A B C to his comrades. Unfortunately (as I think), marching, stable, and barrack duties and elementary discipline are taught to the recruit in a depôt battery before he comes to us. If he has not already begun it in the depôt, on joining a service battery he is taught riding and sword drill by the riding master and the battery rough rider; A B C and the multiplication table are taught by the brigade schoolmaster and his assistants, while driving, gun drill, and gunnery are the only subjects which he is taught in the battery. The essential point in the system I advocate is that every commander, whether Officer or sergeant, shall be held personally responsible by his immediate superior for every detail of the training of his men, whether the said commander personally conducts the instruction or merely supervises from time to time. Thus, I would have him responsible that his men get their 4th class certificates in a reasonable time, and this is not to be ensured by the brigade orderly Officer visiting the school and writing his name in a book kept for that purpose. Decentralization of work should be the leading feature in the system of training. The amount of professional talent expended on the work should be proportional to the extent and quality of the material, and, as Colonel Hale observed, we should not use our razor to sharpen slate pencils. The rank and file non-commissioned officers will, therefore, be employed to put recruits by twos and threes through elementary exercises under the supervision of the sergeants and Officers, and as they become more advanced they will be exercised in larger bodies by the sergeants or subalterns. All drills should be taught in this way instead of making up haphazard squads for the different drills, which is the system at present in vogue. Riding masters in the mounted service, Adjutants and musketry instructors in the infantry, orderly Officers, sergeants-major and schoolmasters of different sorts throughout the Service, do far too much in the way of instruction, and nothing short of their suppression will ensure a proper decentralization of responsibility and work. The Adjutant, however, may be retained for purely staff duties and office work. The great advantage to be secured is that men shall be taught to look to their immediate regimental commanders or leaders for instruction in every detail of their work, and if the said commanders are not competent to do this and thereby win the confidence of their men, which is so essential for steadiness in action, the sooner other commanders can be provided the better. Every commander, from Colonel to corporal, each in his several station, must be competent to carry on the training of the men placed under him, and the state of efficiency of his command will show infallibly whether he is, or is not, efficient himself. If he is, it would seem unnecessary to subject him to examinations. If he is not, the sooner he makes room for someone who is, the better; by compulsory retirement in bad cases, or by the loss of all claim to promotion, for if he has proved himself incapable of producing efficiency in a small body of men, *à fortiori* will he be incapable of maintaining the efficiency of a large body of men, and this seems to me the simplest and most economical way of maintaining a healthy flow of promotion in the Army. But of course you cannot hold the Officer responsible for the produce unless he is entrusted from first to last with the manufacture of the raw material. My proposals, then, are these—(1) The recruit to join service batteries at once, depôts to be broken up and strength divided among service batteries in excess of present establishment; (2) his training to be entrusted entirely to his own non-commissioned officers and Officer from first to last; (3) the non-commissioned officers and Officer to be held responsible for everything; (4) work to be decentralized as far as possible; (5) commanders of all sorts to be judged by the results produced; and, lastly, (6) in pursuance of this

scheme Officers should at least be competent to impart instruction of every kind. For this purpose young Officers on joining should learn and actually perform every part of a soldier's duties from cleaning a set of saddlery and turning out a gun or pair of horses for parade, through the various duties of rank and file, non-commissioned officers and sergeants, up to his own duties as a divisional commander. Gentlemen, I must apologize for trespassing so long on your patience, and my only excuse is that I am deeply interested in the subject of Colonel Harrison's lecture.

Colonel GILDEA, Commanding Royal Scots Fusiliers: I really, Sir, do not know what I am to say, except as a Colonel of a regiment lately returned from foreign service. I have had the honour, for a short time, of commanding a regiment that I consider fit to go anywhere, and whatever any soldier ever did, I am sure they would do. I agree a great deal with what Colonel Harrison has said, but I also agree with the other Officers who have spoken, that the orders must come from a higher authority, and that some system must be adopted to relieve men of a great deal of their duties if these things are to be carried out. I know myself at Pretoria my men for a year and a-half had often not more than two nights in bed, sometimes not one. They were doing nothing but guards and fatigues all day long; they seldom had a holiday for two years, but were always at work. I generally managed to get two days a week for drill, that was all I ever could get. Of those two days I used generally to devote one to shelter-trench drill and practising men in building sconces, exercising the senior Captains, fighting one half the regiment against the other half. I used to send one Captain out with half the regiment, and tell him he was to try and get into the camp if he could, and leave the other half to defend it: at other times we would send the subalterns out. I am sure that all Commanding Officers would do whatever they could to get their men on if they had a certain rule laid down and were left alone for a certain time every year; every one of them would be quite equal to the occasion, and would produce men fit and willing to go anywhere. We are not a very rich regiment, but still there are some of us that are pretty well off, and I differ entirely from the opinion that making soldiers do hard work will drive rich men out of the Service. I think it is a known thing that in the Crimea no men fought better than those of influence, position, and wealth. I agree with Colonel Harrison that we ought to have some system laid down to go by; the one thing that I do not quite approve of is making an Officer a drill sergeant. I think in every regiment there are plenty of sergeants quite able and competent to drill recruits in their rough work; but I would make every Officer entirely responsible for his company. In my own regiment I seldom go near a company; I never see them except now and then, but when I do happen to see one and it is not in order, the Captain catches it. I think the same thing ought to be carried out with general inspections. I have been some years in the Service, and have had a good many cases of a General coming to inspect, when a polishing goes on all over the place. My idea is a General ought to come into the barrack-yard without giving any notice, and then he could see what state the regiment was in. Any regiment can polish up in a fortnight so as to pass the General; they can clean up everything, get their things on all ready, kits and books completed; but the thing for the General to do, and then he would find out what regiment is right or wrong, is to walk into the barrack-yard, and tell the Commanding Officer to fall in his regiment, that he had come to inspect them.

General HERBERT: Had not an attack been made upon General Officers I would not have risen. Colonel Gildea has stated that General Officers are not fitted to inspect regiments, and that a long polishing is considered necessary before their inspections. Colonel Gildea served under me, and I know his regiment well, and I must say it did it a great deal of good to have a polish up occasionally, and that the inspection was very advantageous in this way to the regiment. Everything was brushed up and put in order; I knew exactly the state the regiment was in as regards drill and discipline, having it constantly under my orders in the camp, without going to look at it, but the extra polish would have been put on had there been no inspection. I think in that respect a periodical inspection is a great advantage. A General Officer is not such an idiot as that he cannot tell what state a regiment is in, without making it march past. That is merely done as a form,

which induces the regiment to be smartened and to brush up. I do not think Colonel Gildea could exactly intend to say that inspections are not advantageous, though perhaps he may wish them to be more searching. I do not intend to go into the subject of the lecture, as we have had discussion enough, further than concurring with the lecturer that we ought to have a system of double companies instructed by the Captains or Officers.

Colonel GILDEA: Having served under General Herbert, I may say he is the last General in the world to whom I would impute anything of the kind, but still I must hold to the opinion that there is too much polishing up for the General Officer when he is to come. When I had the honour of being inspected by General Herbert, I had command of the regiment for a very short time—I was only Major then; since then I have commanded myself, and I should be very glad to see him any day of the week he likes, and I promise him that he would find the regiment just as smart as he did after the polish up.

The CHAIRMAN: I am sure that Colonel Harrison's lecture must have made a deep impression upon us. With regard to the first part of the subject, the importance of military training, I do not think anyone in this hall, or any soldier or sailor, can have a different opinion. There cannot be a doubt that no troops are worth anything without being properly trained. With reference to our own English system of training, a very distinguished Officer who took part in the discussion thought that too much stress was laid on the disasters of the British Army—the late reverses of the English Army—as a reason for improving our training; but let us set the reverses aside. I do not think that they furnish the special reason for our requiring a more complete system of training. The real reason is that war has become very much more scientific, and very much more training is required now-a-days both for Officers and men. Therefore, it does not do, I think, to stick to the old system, which succeeded very well when war was not so scientific. The Germans set us a very good example in that, for after no reverses, but after most unprecedented successes, instead of being satisfied with the state of their Army, they have ever since been constantly trying to pick holes in it, and to improve their system,—that I think is the best possible example to us. I do not think we need wait for a reverse before we try to improve. I speak with diffidence before so many Officers of very much greater experience than myself, and also as being now only a civilian; but I must say I am quite inclined to take the same view that Colonel Hale and two or three others have taken as to the absolute want of a system of training for war in the British Army. I do not think there ever was a system of training for war in the Army. Some Commanding Officers no doubt have established a system of training of their own, so far as they are allowed to carry it out, but they are so often interfered with that they have not any opportunity of carrying it out properly. One of the most important things referred to by the lecturer was that we should have a definite progressive system of training; I do not mean to say that it should be a cut-and-dried system laid down and minutely detailed, but there should be a general system which every Commanding Officer should carry out to the best of his ability, according to the circumstances of the climate, the country he is in, the time of year, and so forth. One of the things that appears to me always most damaging to the training of our Army is the absence of individual responsibility of Officers, which has been alluded to by one of the youngest speakers amongst us. No doubt, I think you must make every Officer distinctly responsible for whatever is under him. Beginning from the junior Lieutenant and going up to the Field-Marshal Commanding-in-Chief, every one must be responsible for what is directly under him, and every one should be left to do his work as far as possible to the best of his ability, and then be judged of by the results: that seems to me a most important thing, and therefore I have always been of opinion that Captains should have the full responsibility of their companies, and that all instruction in the companies should be under the direct responsibility of the company Officers, so that Adjutants, musketry instructors, riding masters, and all such valuable persons, should be kept in their proper places. They have done very good work in their time; but now I think we can do without them in great measure, or we ought to be able to do without them, as most of the work which they have hitherto done should fall upon the company and squadron Officers. The lecture

is upon instruction in war for the British Army with its present organization, so that I suppose it is not right to touch upon any other organization. Some of us in this room think that there might be a better system of organization, and one more favourable to training for war, but that I suppose we must not touch upon. With regard to the instruction of the men by the Officers, I quite feel that it is not good to waste a good tool,—to use the razor to cut and chip the wood; that it had better be used for the beard, as my friend Colonel Hale has said; but still I think Officers ought at any rate to fully understand how their men are to be instructed in the most minute parts of training. If they do not understand this thoroughly they cannot judge of the manner in which that training is imparted by the non-commissioned officers, so that I think they ought to begin at the commencement by learning to drill squads in the most minute parts of training, that afterwards as they rise to the positions of Captains of companies and Senior Lieutenants of companies, they should only superintend the minor points of drill whilst personally instructing in the higher branches of training, somewhat on the principle recommended by Lieutenant Edwards. The lecturer said very little about inspections, but it has always appeared to me that the degree of training depends a great deal upon inspections by General Officers; and with my friend General Herbert's leave I will say that it always appeared to me that General Officers made very useless inspections; I may say that now that I am not in the Service; it always appeared to me that inspections by General Officers were, as a rule, a mere farce. I have seen some inspections that were really practical, but that was in India. I must say I never saw a practical inspection in this country. I do not mean to assert that it is the fault of the General Officer, but I think it is the fault of the general system; I know what the confidential report of the General Officer was in my time, and I know that he had to report on very little that was practical with regard to training, but chiefly on outside show. There is nothing as far as I have seen in the General Officers' inspections that really tells upon the training of troops in war. I never saw a General Officer take a regiment into the field and practise it in outpost duty except in the mere rudiments. I have seen that done in India, where a regiment has been taken a good many miles out, and has really carried on outpost duty in a practical way; but I never saw it done at home. I never saw a General Officer inspect a regiment in field firing; I never saw anything, in fact, but inspection in the barrack-square, drill, marching past, and rudimentary tactics. It appears to me that until that system is altered, you cannot expect Commanding Officers to train their men properly; my only hope is that it will be altered. I will not detain you longer, but will ask Colonel Harrison to reply.

Colonel HARRISON: It seems to me that there is very little for me to say, for each Officer who has got up has answered very nearly what has been said by his predecessor. One point which I may mention is that several Officers have spoken of the Officer as a "drill sergeant." I particularly wish to lay stress on the fact that the training of the *recruit* is a process quite independent of the *subsequent* training of what I call the *second class soldier* by the Captain and Officers of his company. I would not give up the Adjutant; you *may* do without him in the artillery,[1] but I do not think you will be able to do without him in either the cavalry or the infantry. The Adjutant and Commanding Officers will all have plenty to do, as it seems to me. Leaving to the Adjutant the training of the recruits with *so* many sergeants and corporals under him, the Captain takes up the work where the Adjutant finishes, and instructs his men in what is required to *train them for war*, that is, in outpost work, in the attack and defence of a position, to form an advanced guard, to form bivouacs, and all those duties that are so *absolutely essential*, and *without which* a *soldier is almost useless*. One point, as Sir Thomas Acland has said, and very truly, is that the sergeants are not always up to their work. Of course I can see a good deal of them, going about as I do every day at Aldershot, and I know that the difficulty is much felt in all regiments, that they cannot get a sufficient number of sergeants qualified to instruct the recruits. But with a good system *that* will improve every day. The

[1] This was said in allusion to the remarks of the only Artillery Officer who took part in the discussion. It was not given as an opinion of my own.—R. H.

better the system we have, and the more it is worked, the better drill instructors shall we have to carry out the instruction.

Sir THOMAS ACLAND: I did not say that they were "not up to their work;" what I said was, that they did not *know how to teach*. They know their work, but they do not know how to teach.

Colonel HARRISON: I go one step further, and say that they do not know their work. This is what hundreds of Officers tell me, that they find it exceedingly difficult to get qualified instructors. I know that the sergeants do the best they can; but they have not at present the time, the opportunity, or the means of getting *for themselves* the instruction required to enable them to teach others. Of course the *very best man* is required to train recruits. I do not think there is any other point on which I need say a word.

The CHAIRMAN: Gentlemen, you will allow me to thank Colonel Harrison for the very excellent lecture he has given us, and also all those who have taken part in the discussion.

Friday, February 24, 1882.

VICE-ADMIRAL H. BOYS in the Chair.

MACHINE-GUNS AND HOW TO USE THEM.

By Mr. W. GARDNER (late Captain U.S.A., and Supt. Gardner Gun Company).

I FEAR that I shall ill repay the honour conferred upon me by the Council of this Institution. I hesitated to accept the invitation to read a paper on "Machine-guns and how to use them" because I doubted whether I could find time to prepare such a paper as I could wish to read, but I determined to take time; this I regret that I have been unable to do. However, having accepted the invitation, I shall endeavour to express my ideas on this subject; and, though you will find the manner crude, I trust you may find some freshness in the matter. I believe that every man who thinks is worth listening to.

I like the subject as given to me—"Machine-guns and how to use "them." How to use them. Let us transpose this subject and say: "What we wish to do, and the best tools with which to do it." The purpose precedes the means or instrument. That I may make what I have to say on machine-guns more clear, I must ask you to allow me to speak briefly on the general subject of war as I understand it. Success in war to-day belongs and will result to the nation that has made the best preparation for it. The greatest number of soldiers is very important. High discipline is necessary. The highest attainable harmony of organization cannot be over-estimated. The arms should be the best of their kind, and of such kinds as the exigencies of the campaigns probable or possible make most available and effective. Arms should also be provided in far greater quantity than is barely sufficient to supply the number of soldiers at the disposal of any country. Large stores of suitable clothing are very important. The food furnished to an army often determines its fate. Then comes transportation—the everything of war; the rock on which so many split.

Let us for a moment consider the value of theory as an aid to practice, and the great difference between actual war and most of the theoretical studies used in preparation for it. We wonder what it will be like under the new conditions, and try to anticipate. When it comes we find it quite different from that for which we had provided. We had laid down rules for the game, but the enemy violates them. Smoke obscures our vision. The ground on which we must fight does not suit the preparations we had made. Forced marches and night attacks, rains, floods, snow, and ice, and mud come to be grappled

with. These are our most formidable foes, and they should be well considered in our preparations. Our arms should be the most available and effective under all these conditions that we can get. We should never forget that the enemy will always endeavour to do exactly the reverse of that we wish him to do.

In all considerable modern wars the question of food is the one soon put. By this I mean capitulations of vital points are compelled by starvation. I believe it probable that in event of war between any two of the great Continental Powers, one would be shut up in its fortresses inside of six weeks, as was the case in the Franco-German war with France. In this case the army acting offensively assumes the defensive. So that an army acting offensively must be supplied with the arms best adapted for the defensive.

We hear many beautiful plans for making war safe and comfortable for ourselves, and at the same time most destructive to our enemies. Among these is the talk (I cannot call it an idea) of so improving arms as to make battle decisive at long ranges. I can imagine two scientific armies meeting and fighting on this scientific plan for a little while, till they have produced a lot of smoke, then I should expect one to weary of play and get to work. I do not believe the fire of any arm is much to be feared beyond 1,000 yards, except that of machine-guns.

In considering the arms of an army I should first consider their availability. Will they be useful under almost every possible contingency of campaign? If so, good; if not, they are not worth taking along. The next question I should propose to myself about an arm is, Is it reliable or is it capricious? I prefer a pair of walking boots to a balking horse, and a club to a machine-gun very liable to jam.

Every element of an army has or should have not only its use but its duty, its part of the whole work to do. In battle, to fail in our individual duty, is to imperil the whole army. So with arms.

"*C'est magnifique, mais ce n'est pas la guerre.*" In other words, the solid and the brilliant in war. The great end and the individual. The sum total of weakening and agony heaped on our foe and the newspaper fame of our comrade. I believe most of the solid work of war is now done in the trenches, in their making and defence.

We have now reached our subject proper. What we wish to do, and the best tools with which to do it. Let us ask ourselves the question, Why have machine-guns come into existence? Why does any tool come into existence? Man is defined to be a tool-using animal. Why does he constantly devise new tools? Does he devise the tools, and then seek an opportunity of using them, or does he wish to accomplish an end and devise the tools requisite to accomplish it? Machine-guns have come into existence in response to a demand for a something. Between a longing and a definite idea of what it is we want, there is a considerable space. In war we found we had no adequate means to deliver a rapid, accurate, and continuous fire in the smoke and excitement of battle. Our enemy took advantage of this. We at once resorted to various new plans to thwart him. Breech-loading rifles, magazine rifles, revolvers, artillery with shrapnel and

case-shot; still we had it not in our power when the smoke became thick to stop him. These devices were steps forward, but were not the means our fancy had painted. The next answer to the problem was a machine-gun, but it was a very crude machine-gun. It was suggestive and encouraging. It enabled us to more clearly define to ourselves what a machine-gun should be. This led to numerous productions, comprehending almost every possible plan and embodying almost every possible device in detail. The darkness in which we worked is now lighted up and we can see our way to the end.

The uses to which machine-guns are adapted are so well understood that it is superfluous to enumerate them. They are practically useful everywhere in battle if they are light enough to be generally available, and if they can be relied upon to do their work continuously. There is but one use of them, and perhaps the greatest, I have not heard sufficient importance attached to—"blind firing," I believe, is our name for it; that is to say, firing when we cannot see the enemy. With muskets this is little better than a waste of ammunition, but with machine-guns the case is different. If we lay a machine-gun, it does not require relaying after firing a shot, as all other arms do. We can lay our machine-guns when the air is clear, so that they shall cover the roads, bridges, passes, and routes, whatsoever they may be, that the enemy must pass to operate against us with advantage. In this way we can draw "dead lines," that is to say, forbid effectually the passage of the enemy by the ways he had chosen and in the manner most advantageous to him.

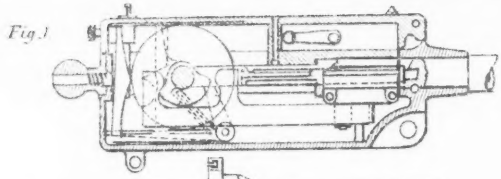
There has been a considerable variety of opinion as to the limit of the calibres of machine-guns. More than four years since, after a long and careful study, I was satisfied they should be limited to musket sizes. The machine-guns of an army should use the same cartridge as the muskets of such army. Larger cartridges confer no compensating advantage. Musket-balls do the killing and wounding in war. Artillery is useful and necessary to force the enemy out of cover of houses, walls, &c., &c.; but it is a very great extravagance to kill men with cannon. A musket-ball is quite sufficient. If the enemy takes refuge behind the walls of houses, gardens, &c., he is secure against musket-balls; it is then we want artillery to knock down these walls, and in this case the fragments of brick or stone are the real missiles that do the work. Where the enemy has artillery, I should prefer to be in front of a wall rather than behind it. If we will but be provident and industrious, Mother Earth will always soon give us a comparatively safe refuge from artillery. Men can dig deeper than cannon-balls. One word here about cannon with shrapnel shot doing the work of machine-guns. Some zealous artillerists have claimed they could do it equally well. They certainly lack continuity of fire, and though a shell should explode just where we want it to do, it scarcely ever does. Large calibre machine-guns are unnecessary to do the work of musket-balls, and are not able to do the work of cannon.

Allow me here briefly to call your attention to the great danger of attaching undue importance to one detail in examining the general question of machine-guns. "How fast can you shoot?" I am asked.

"How long can you continue to fire, and how much does your gun "weigh, and is it strong and simple?" I ask. I make a distinction between a cartridge-destroying machine and a machine-gun. It is the number of hits on the enemy, not the number of shots fired, that we care to score. Cartridges are not generally so plentiful on the battle-field that it is well to waste them. I should place the qualities of a machine-gun in order of merit about as follows, viz., reliability, strength, weight, simplicity, durability, ease of manipulation, rapidity of fire. Of course these qualities must be considered together to form a proper estimate of a machine-gun, but I should give them weight about in proportion to this classification.

Now let us consider whether the use of machine-guns tends to waste or to utilize ammunition. As machine-guns enable us to deliver a terrible fire, with great accuracy, at any moment, we can safely hold our fire till it is really wanted. I believe machine-guns put it in our power to say effectively to an assaulting enemy, "Stop!" So, as we dare admit the enemy within our grasp, we save all that desultory firing which does no good and leaves us without cartridges when we really have use for them.

Let us now consider a most important question in connection with machine-guns. How shall we carry them? The question of their transportation is an almost vital one. The answer usually given is: "On a gun-carriage." I say most emphatically that a gun-carriage is neither a suitable vehicle for their transportation nor a suitable rest from which to fire them. If the gun-carriage is as heavy as a field gun-carriage, and so able to hold its own on the road, it is overloading an army with superfluous weight. If it is a light one, proportionate to the weight and recoil of the machine-gun it has to carry, it is a toy that will come to grief in company with field gun-carriages, army-wagons, ambulances, &c. It will be crushed or thrown into the ditch in case of a block. Besides, the machine-gun thus mounted will be subject to blows it cannot endure; and the jolting of the road, the dust or mud, and the fording of streams will expose the guns carried in this way to an amount of rough usage that will leave them, to say the least, in a bad condition for work. I would transport machine-guns intended to co-operate with artillery on the limber of the cannon, mounted on a pivot placed between the limber boxes. Beside the gun I would carry on the limber a light tripod from which to fire the gun, and a supply of cartridges. I would so arrange that the gun could be fired from the limber, either when stationary or in motion, and also that it could quickly be taken from the limber and fired from the tripod. Also, I would provide that the gun and tripod could be very quickly restored to their places on the limber. This plan, I think, it will be found is in all respects the best where machine-guns are employed with field artillery. When machine-guns are to accompany cavalry or flying columns of infantry I would pack them on horses or mules. I will here say, by way of parenthesis, I believe there is but one machine-gun for field service, and that is my own one-barrel gun. A good horse or mule will carry one of these guns, its tripod, and one thousand cartridges—an in-



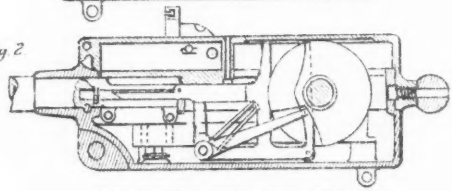
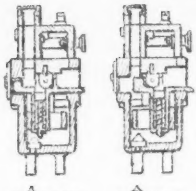


Fig. 1.—Vertical Section, right side.
„ 2.— Do. do. left side.



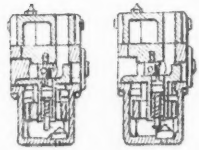
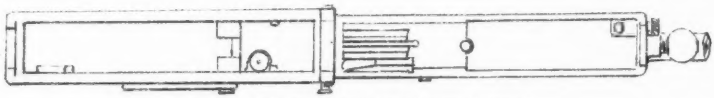
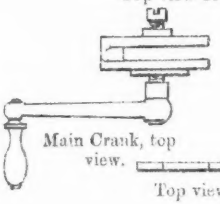


Fig. 3 and 4, Transverse Vertical Sect
looking to the rear; and Fig. 5 and
do., do., looking to front end.

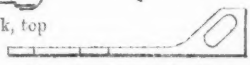


Top view of Case, hinged top thrown forward.

Top view of Lock.



Main Crank, top view.



Top view, Controller Bar.

Cartridge Carrier.

Spanner.

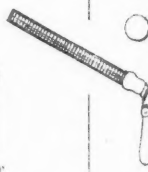
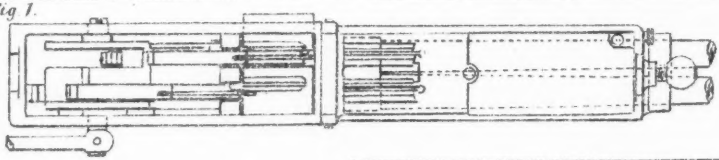
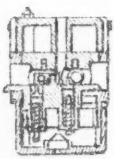
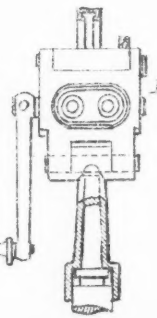
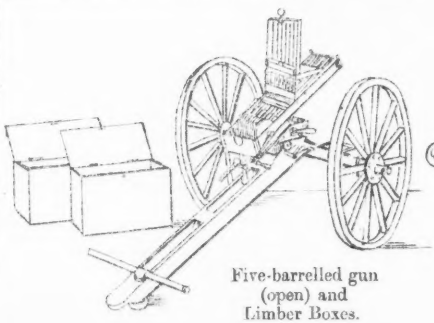


Fig. 1. 2. 3. Two-barrelled Gun.









Five-barrelled gun
(open) and
Limber Boxes.

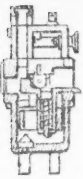


Fig. 4.

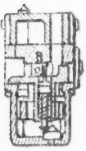
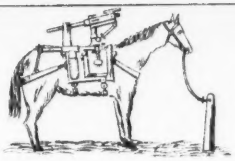


Fig. 6.

e Vertical Sections,
and Fig. 5 and 6,
to front end.



Gun portable rest
and 1,000 cartridges
(weight 200 lbs.).

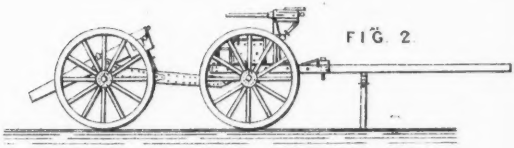


FIG. 2

Gun bolted to Limber (weight 200 lbs.).

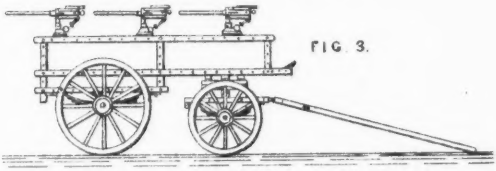
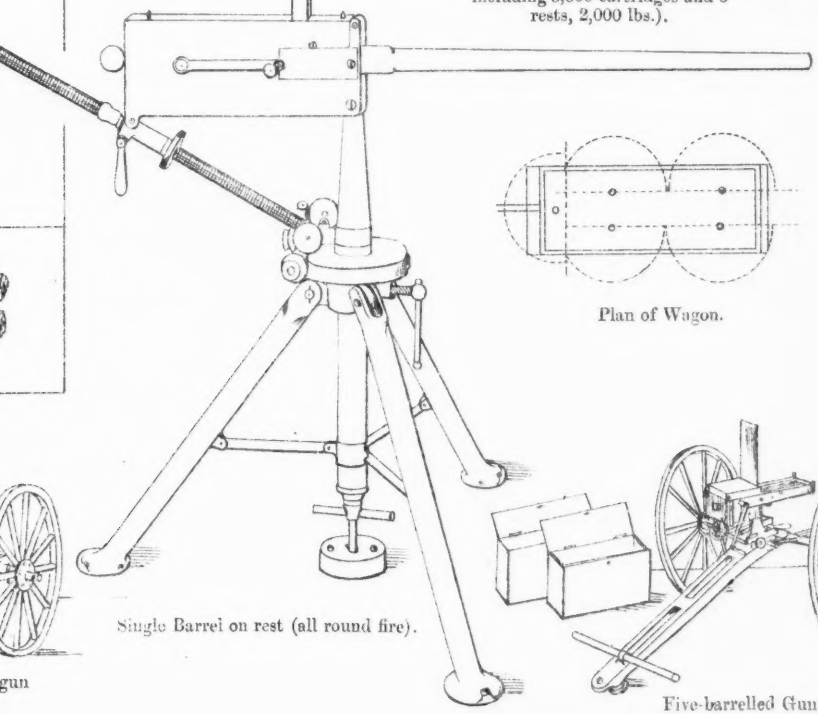


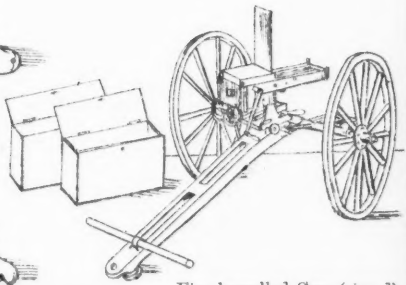
FIG. 3.

Battery of 5 Guns on light spring wagon (weight,
including 5,000 cartridges and 5
rests, 2,000 lbs.).



Single Barrel on rest (all round fire).

Plan of Wagon.



Five-barrelled Gun (closed)
and Limber Boxes.

gun

s.

dependent unit. With a heavier gun, either the tripod must be carried on another animal or the number of cartridges carried must be very small. The advantage of having gun, mounting, and ammunition together needs no argument. When machine-guns are to co-operate with the main bodies of infantry, I would transport a battery of five guns and ten thousand rounds of ammunition, and the tripods from which to fire the guns, in a spring wagon of about the strength of an ambulance. As I have said before, a machine-gun on a toy gun-carriage would fare badly on the march, but the surgeon carries glass bottles safely in the ambulance. I believe two batteries of five guns each are quite few enough to a battalion of infantry. I am talking about my one-barrel gun. So that, to recapitulate: with artillery I would carry the gun and its equipment on the limber, with cavalry packed on a horse, and with infantry in a spring wagon. I said I did not consider a gun carriage a suitable support from which to fire a machine-gun. I will now say why. It is not so steady as a good tripod, and is not nearly so convenient, and it weighs about ten times as much. Of course heavy machine-guns require a gun-carriage; but we do not require heavy machine-guns. As may have been noticed, all of the ideas I have advanced relative to the use of machine-guns have applied to their employment with field armies. Naval service I know nothing practically about.

So far I have only spoken generally of the conditions under which, as I believe, machine-guns will have to be used. I have endeavoured to show, in a very general way, what they should be and how to transport them. How to use them in fortresses and field earthworks, and how to use them on ship-board, and on launches, and with landing parties of sailors on shore, I can only indicate in most general terms. When a rapid, continuous, and accurate fire of musket-balls is desirable, a machine-gun should be employed to deliver them if possible. I would prefer a good machine-gun that would fire two hundred shots in a minute, if wanted, to a hundred of the best infantry in the world to hold a line. The percentage of hits made to shots fired in battle clearly demonstrates that it is an accident if a soldier with a musket makes a hit. The conditions under which he has to fire are not conducive to good target practice. I wish here to read an extract from a lecture delivered before this Institution by Lieutenant-General the Honourable Arthur E. Hardinge, on March 14th, 1879.

"It is an established fact, that the containing power of infantry has and may yet further increase by the increased range of its arms; but the problem of its adequate use is complicated by the opposite demands of a maximum of fire and a minimum of exposure, and yet, of reserves sufficiently solid and in hand, to act on shaken points, as columns of assault; in short, the defensive-offensive deployment of an advanced guard as an auxiliary to the preliminary artillery action would solve many difficulties, if it could be depended upon to hold its ground plying the enemy with effective fire, until its reserves, moving up, push the issue to closer quarters. Such a force of auxiliary rifles might at first be advanced to within 1,200 or 1,000 yards of the enemy; a judicious dispersion would exempt it from heavy loss; its front and flanks would be protected by the cross-fire of its more retired artillery; the present impossibility of replenishing the ammunition of a moving fire line, or of relieving it, would vanish with the expedient of a more or less stationary base, for a

patient delivery of lead into the perimeter of the defence; and should the enemy attempt to force its thin line, such counterstroke must bring denser formations under the deliberate fire of an overlapping curtain, which, if obliged to yield, would fall back upon its supports. Small groups of marksmen, detached from this general cordon, might use cover for closer approach to the position, understanding that the object of their employment was to harass the enemy, without too far compromising themselves."

Shortly after this lecture I had the honour of an interview with General Hardinge, and learned from him that his plan contemplated the employment of half companies to deliver this deliberate fire. Here is certainly a good use for machine-guns.

The subject of the detailed use of such a gun as my one-barrelled one is so vast I hesitate to enter upon it. I believe it to be available everywhere, and useful everywhere. I can only repeat that where a rapid, continuous, and accurate fire of musket-balls is desirable, a machine-gun should be employed to deliver them if possible.

As it is contemplated that a discussion should follow my paper; and as I have no doubt the discussion will be much better worth listening to than anything I have said, I will close by thanking you for your kind indulgence.

Major-General Sir EDWARD HAMLEY: The value of our lectures and discussions here consists in this—not so much that we settle questions, as that we sift them; and the present question has formerly been to some extent sifted in this room, and with this result, namely, that certain points appear to have been arrived at by general consent, both for and against the employment of these weapons. It is considered that they could not be usefully employed in attacking positions armed with artillery. It is also considered, at least by British and German authorities, that it would not be expedient to diminish the field artillery of an army in order to substitute machine-guns. There are some who have even gone further, and would not admit them even as supplementary to the field artillery on account of their increasing the impedimenta. On the other hand, it is believed they could be used effectively in the flanks of works, and in defensive positions at points where, secure from artillery fire, they could develop their own. It will be seen that on all these points they have been more or less considered in comparison with field artillery, that is to say, with reference to European warfare. Now, there are certain points which suggest themselves to me, in which they may be considered without reference to European warfare. For example, I should like much to have the opinion of Officers who served in the Afghan campaign as to the degree of help they might have expected to derive from these weapons in advancing through the difficult passes, and in the battles about Cabul and Candahar, where, if the enemy had artillery, he was not very competent to use it with much effect. And this particular case would lead to the consideration of the more general question as to the expediency of employing them in mountain warfare, where portability is a great merit, where they might not be exposed to field artillery, and where the area of the engagement would very often be so far restricted as to enable them to develop their own fire with advantage. Next, I should like to have the opinion of Officers who served in our late African campaigns, as to their effect against a barbarian enemy; and this again would lead to the further consideration of the general question how far they would be useful in bush fighting, how far their fire would search out an enemy who was not visible, but of whose locality we had a pretty accurate idea. Again, a very different question is, what use might be made of them for home defence. Of course, all the positions on every possible line of invasion would be known, or ought to be known, beforehand, and points might be indicated where these weapons might exercise their peculiar qualities. Also, in the case of insurrection they might be useful, especially in street combats, where they would reach the objects it was desirable to reach without doing unnecessary damage, for instance, by injuring buildings beyond.

Well, all these are questions which more or less immediately concern ourselves; but there are some of more general scope. I think it has formerly been suggested that they might be employed with outposts, and possibly there are cases where they might be very usefully attached to the main body of the outpost. I can imagine, too, many cases in which they would accompany cavalry with advantage, where they would be brought into action much more speedily than field-guns, and where, in a very brief space of time, they could produce an effect on a hostile force of cavalry which would render the subsequent charge of our own decisive. And, lastly, there is a question of taking them along with artillery, which may be worth consideration, because we know that it is a problem, and, for many reasons, not a very easy one to solve — how artillery may best derive protection from infantry. And now the question arises whether the special protection of infantry might not in some degree be dispensed with by making use of these weapons. I do not speak of these points as at all settled in my own mind; they have only suggested themselves within the short time in which I have lately given some consideration to the subject, and it will be observed that I have raised points upon which the lecturer has not touched, while at the same time I do not pretend to go so far as he does in ascribing universal excellence to the machine-gun; it is not my business, as it is his, to set forth to the utmost advantage the merits of his own invention. But these points appear to me to be sufficiently important to warrant further inquiry into the capabilities of the machine-gun, and, viewing the subject as one well worth consideration, I will conclude by saying that I for my own part feel grateful to the lecturer for giving us the benefit of his experience and his ideas concerning it.

Lieut.-General Sir Beauchamp Walker: I rise with no intention of criticizing Mr. Gardner's lecture, for which, as Chairman of the Council, I may say that we are extremely indebted to him. At considerable trouble to himself he has given us a lecture which is very suggestive, and which I can honestly say gave me a couple of hours' very hard thought last night. There are only one or two points in his lecture to which I intend to advert, because I do not wish to appear captious; but I will pass on afterwards to a few remarks of my own, which have been seething in my brain for a great many years. Mr. Gardner says he does not believe in the fire of any arm beyond 1,000 yards, except that of machine-guns. Field artillery in the present day ranges to 4,000 yards, and we have no machine-guns, I think, whose range is greater, or whose power is more effective, except in a very minor degree, than that of the small arms of the present day. Ours is not even the best small arm. I believe that one nation certainly, perhaps two, have a better small arm than our own. Mr. Gardner asks very aptly, "Why does any tool come into existence?" The machine-guns which were first introduced were those of the French, commonly called the mitrailleur, in the war of 1870–71. I perfectly remember the first rumours that arose in Berlin, of the French, who always anticipated the possibility of a war with Germany, having a weapon which was to give them an advantage, which at that time they had not, in not having a breech-loading small arm. They afterwards introduced the Chassepôt, which placed them on a greater equality, or even in a position of superiority, to the Prussian Army, and the machine-gun was taken into the field, despite the well-formed opinions of some of the more thoughtful of the French Officers. As Sir Edward Hamley has so aptly said, it becomes a question whether you are to diminish your field artillery by one single horse, or one single gun. The artillery, valuable as it is, and great as is the part it plays in modern warfare, is an encumbrance to the army; the horses have to be fed, and the carriages block up the roads. It, therefore, as Sir Edward Hamley properly says, becomes a very great question whether you shall diminish your artillery, or whether on the other hand you dare add mitrailleurs to the artillery which you already have. Certainly, the greatest objection to the French machine-gun was, that it was very apt to fall out of use from jamming. In thinking of that, I am reminded of the old Irish saying which I heard a great many years ago, when first in that country, that the "shillelagh never missed fire." The Irishman prefers a stick to any other weapon; there is no jamming there. In one point I entirely concur with Mr. Gardner, that is, that we should have one ammunition for all the small arms of an army, and certainly, the machine-gun, if introduced, should have the same ammunition as the small arm of infantry. I think, myself, from an experience of a good deal of hard service, I

should like to see in the army in which I serve all the ammunition of the same calibre, pistols, revolvers, rifles, all the same. There is no greater encumbrance to an army than having different kinds of ammunition, or one that leads to more trouble or more difficulty. But if, as Mr. Gardner says, he is satisfied that the calibre of machine-guns should be limited to musket size, I do not quite see how he intends to get a much greater range than that of the arm carried by mobile men, whom you can handle as you please. He further says, "The question of their transportation is an almost vital one." But the difficulty with machine-guns does not end with transportation; there is another difficulty, and that is their protection and the means of getting them off the field if you wish to do so. This is no very great matter if the operation in which they are engaged is successful, but how in the case of the reverse? A gun which has no means of being moved off the field by its own horses, which you can attach readily and take away, must be left. That was the case of the mitrailleurs. If not successful in action, they were carried with a rush, the French had no time to get them away, and they were taken by hundreds. To the question of attaching mitrailleurs to infantry, I am very much opposed. I do not think infantry ought to be encumbered with anything in the shape of a gun, and I believe that is the opinion of most men who have served long in the field, and it certainly is the opinion of the infantry themselves. I particularly remember what was said in Berlin, when the question was very carefully discussed after the war: "The infantry won't have them, and the artillery don't want them." That was the conclusion arrived at after careful discussion. If machine-guns are to be used as attached to batteries of artillery, considering their limited range, I do not quite see what their function is. It is now the habit of the present day to run up artillery within 800 yards of a fire-line of infantry. Artillery now is massed at the commencement of an action in an advantageous position, from which the batteries probably never stir, until the infantry have completed, or nearly completed, the business of the day. Of what use would the machine-guns be in that case? They would be at an enormous distance, where their fire would be totally ineffective. I was so much interested in reading the lecture, that last night I turned to certain portions of the despatches which I wrote while in the field with the Prussian Army in 1870–71. I find the first contained rather a rough remark, which was to this effect. It was a despatch which I wrote on tactics and armament: "I can hardly conclude a memorandum of this nature without adverting to the mitrailleurs. The introduction of this engine into the French armament was, as I have already expressed myself, a gigantic swindle, and was intended to cover the deficiency of a breech-loading infantry firearm. The results have been in no way commensurate with the expectation formed, and although the weapon is probably capable of improvement, and is certainly very formidable under certain conditions, I do not think that it will ever take the place which its upholders expect." I referred further to the answer to a demand which was made on me in the spring of 1871, to report more carefully on the actual use of the mitrailleurs, and I find myself ending a sentence with these words, words which have been in my thoughts ever since, presenting a problem which I have not yet been able to solve: "The question which I have turned over in my mind during the last nine months is simply—what am I to do with mitrailleurs tactically? Are the mitrailleurs to come into my *ordre de bataille*; if so, where? Am I to give up a battery of field artillery with a view to replacing it with one of the mitrailleurs, or are the mitrailleurs to be supernumerary to my establishment of field-guns?" In that respect my thoughts of so long ago coincide very much with what Sir Edward Hamley said just now. The Germans took something like 600 of the French mitrailleurs, and never attempted to make the slightest use of them. The only mitrailleurs brought to the campaign were two Bavarian batteries of four guns each, which were of such faulty construction, and proved so absolutely useless, that they were sent out of the field, one without being used at all and the other after only being used twice. The conclusion come to by those who considered and criticized this subject was that this four-gun battery was not as useful as 100 infantry soldiers properly handled. The despatch in which I mentioned the conclusions arrived at by Prussian Officers was written on the 6th May, 1871, after the greater part of the staff of the Army had returned to Berlin, and after the question

had been very carefully considered: "I have no hesitation in stating that the opinion entertained by the Prussian Officers on the subject of the employment of these weapons generally is very little favourable to their introduction." I must not quote the opinions of individuals: "The opinions now prevailing are decidedly adverse to the introduction of the mitrailleur as a field weapon, but the very decided manner in which these opinions are expressed would lead to the conclusion that there must somewhere be a party favourable to their introduction. I have not heard a single opinion in their favour, that is to say, when employed either with infantry or artillery in the field, and I must fully concur in these opinions. The infantry entirely decline having anything to do with them, but desire a better fire-arm than the now superannuated needle-gun. The artillery repudiate the very idea of being saddled with these weapons, and ask only that they may be furnished with an efficient shrapnel." I have had various opportunities of seeing the effect of engines of war on other people, and I have no hesitation in saying that the explosion of a shrapnel shell in the middle of a company of infantry produces far more confusion and is far more hurtful to the nerves of those who are under its fire than that of anything of a smaller calibre. "They (mitrailleurs) were first introduced in France *because* the infantry had no breech-loading firearm, and were therefore at a disadvantage. They were first made an adjunct to the infantry. As soon as the Chassepôt was introduced this most inconvenient tactical arrangement was abolished, and the mitrailleurs were formed into batteries of six pieces, and became field artillery. It will hardly be alleged that mitrailleurs have the same sphere of action as field-guns. Their effectiveness, to say the most for them, is limited to that of field-guns when firing canister or shrapnel. But the amount of artillery which an army brings with it into the field is limited by *transport* considerations, and mitrailleurs require nearly as many men and horses as field-guns." Now, I have no doubt that Mr. Gardner's mitrailleur is very much more mobile than the mitrailleurs used by the French; but I do not quite see, any more than I did in May, 1871, where its tactical place is, and that, I think, is the great and hitherto not overcome objection to machine-guns with an army in the field. There are places where they are of admissible advantage. I reported at the same time that I considered that in the defence of ditches, probably also in boat service, in the tops of men-of-war, and in other positions where no very extensive range is required, but where you require a very great amount of musketry fire, their use would be desirable; but I certainly formed the conclusion in 1870–71, from personal observations in the field, that their use, and the mode in which they were to be attached to an army, was a subject of very considerable doubt.

Major-General Lord CHELMSFORD: I cannot pretend to offer many remarks which will be very useful in this discussion, as my experience of these machine-guns has not been very great. In South Africa we had the Gatling, but I do not think it is fair to condemn machine-guns because this pattern rather failed in the time of trial. In the first place it had ammunition which was not the same as the infantry ammunition—as Sir Beauchamp Walker has said, a vital failing in any weapon which is taken into the field; and in the next place, they were very much given to jam; and they did so at Ulundi. At the same time, in the battle of Gingilhovo, when I was marching to the relief of Etchowe, it is only fair to say that the Gatling gun, under the charge of the Naval Brigade, did very good service indeed, as was shown afterwards by the number of dead Zulus found on the ground which had been exposed to its fire. I think myself that machine-guns have been rather harshly judged on account of the failure which, no doubt, in the outset, has been experienced in using them. With all due deference, however, to Sir Beauchamp Walker, and I feel it is rather difficult to go against such good authority as his, I cannot help thinking there is a future for these machine-guns, and I think there is a future for them, not as employed with artillery, but as employed with infantry. I can safely say, at all events in such wars as we have to carry on in South Africa, that machine-guns attached to infantry, if they are of a simple and reliable nature, carrying the same ammunition as the infantry arm, would be of inestimable value. Small detachments have repeatedly to be left in charge of posts on the line of communications, and in such positions I am satisfied that these machine-guns would give very great confidence indeed (supposing, of course, that they were reliable) to the detachment

in charge of the post, and, in case of its being attacked, might be used with very great success. Of course, with regard to its tactical application in European warfare, that is a very much wider subject, and one that I hardly feel able to grapple with, but at the same time, with our Army, numerically small as it is, if this machine-gun can be made, as Mr. Gardner says that his gun can be, so light as to be carried on a single mule, together with 1,000 rounds of ammunition, I do not see any reason why it should not be employed in certain proportions with infantry. The infantry ammunition has to be carried upon mules into action, and there is no reason that I can see why infantry should not be trained so as to use a machine-gun of a light and useful size, such as Mr. Gardner describes. It would supplement the deficiency in numbers, which we must always have to encounter when we take the field, and might be usefully employed when attacking an enemy in position, where we do not intend to make more than a feint in front, to hold him there with a small force of infantry, whilst the rest of the force made its attack on the flank.

Captain CLEVELAND, R.N.: The machine-gun has been treated from a military point of view; I wish to say one or two words for it from a naval point of view. It is of inestimable advantage to us as a means of destroying torpedo-boats, which will be launched against our large ships in action. It is proposed to use an outrigger defence, and when the boat is "hung up" by these to destroy it by means of the machine-gun. The projectile must certainly be a larger one than the ordinary rifle carries (as recommended by Sir B. Walker), because we want to penetrate the boiler and destroy the boat. I am sure from a naval point of view it is certainly a great advantage to us. It will do what our guns will not do, because we cannot depress them sufficiently, and what our small arms have not sufficient power to do. It will also be useful in our boats for clearing the beach preparatory to making a landing. From these two[1] aspects only I think very highly of a machine-gun. I speak with no reference to Mr. Gardner's; the only one I have had any experience with has been the Gatling, which we know to be very defective. The Nordenfelt seems to supply many of the wants we require, and it seems to me superior to Mr. Gardner's, but I am ignorant of the details of his machine.

Sir EDWARD HAMLEY: May I say a word in explanation of something that Sir Beauchamp Walker adverted to, that is to say, as to what I had in my mind in considering the employment of this machine for the protection of artillery? I was contemplating the case of an attack upon guns by infantry or cavalry in loose order. There is no case in which artillery fire is less effective than where a thin line of troops is advancing swiftly either upon the front or flank of the guns. In that case it appears to me that this weapon might be efficiently employed. I have only made these suggestions because we have at present no machine-gun in our land Service; but I do think that some of the points I raised are worth further serious consideration, and the taking of some evidence from those who are best able to judge as to whether under certain circumstances (which they themselves have been concerned in) these weapons might not be usefully employed. No doubt the reasons which Sir Beauchamp Walker has given us why the Germans have rejected them are very potent, but on the other hand we must remember that the Russians and Austrians possess them in great numbers; and it was only yesterday I observed in a despatch from Constantinople that the Turks have ordered 200, and intend to increase that number if they are found useful. I need not say Turkey is not at present in a position to embark in expensive contracts without some very good reason, and no doubt her Government is, in this case, acting under advice which it considers sound.

The CHAIRMAN: As the discussion seems to have closed, I should like to make one or two remarks with regard to the lecture. And I will first observe that Mr. Gardner's lecture has not been confined to his own gun, but he has dealt with the subject of machine-guns generally. Neither has it been a case in which guns of one description have been compared to guns of another description. One trite observation made by Mr. Gardner, which I would beg to repeat, was that "the enemy will always endeavour to do exactly the reverse of what we wish him to do." I think

[1] I should have added a third, "clearing an enemy's deck in close action."

that is probably true. Mr. Gardner says, "I do not believe the fire of any arm is much to be feared beyond 1,000 yards except from the machine-gun." Perhaps he will explain presently why he considers the machine-gun superior to any arm beyond 1,000 yards. He has confined his remarks more immediately to the Army, and he considers that for the Army the calibre of the machine-gun should be the same as the arm of the Service. In that I am perfectly willing to agree with him; but for the Navy I consider it an absolute necessity that we should have a larger description of gun for the very purpose, as Captain Cleveland said, of stopping the attacks of torpedo-boats and such like vessels, and also for penetrating the thin sides of unarmoured ships. But there is also a place in the Navy for the small machine-guns (it is a *sine quâ non* that it must take the ammunition of the Service), and that is for firing on an enemy's deck at exposed Officers and men when ships close, for firing down from the tops upon the roofs of turrets, and also into an enemy's ports, because one of the disadvantages of the long breech-loading gun is, that it must be loaded with the port open. In the muzzle-loading days the guns could be loaded in the "down port" position, which is, that the port is lowered while loading, and in this port is a small aperture to allow the staff of the rammer to pass through, so that the men were to a great extent protected; but now with the long rifled guns as at present arranged the port must be up in action, and that will admit bullets, particularly from the fire of the small machine-gun. I am sure we are all greatly obliged to Mr. Gardner for bringing this subject before us in the way he has done.

Mr. GARDNER, in reply: I have only some crude ideas to express, and I express them in a crude way, but I believe what I say. I say I do not believe in large calibre machine-guns. I believe this as I say about them, that large calibre machine-guns are unnecessary to do the work of musket balls, and they cannot do the work of cannon. If you leave the musket calibre, where will you stop? You cannot stop anywhere short of knocking down houses. I have not only had the benefit of my own thought in this matter, but also the experience of a Russian Officer who was killed by the explosion of one of his own cannon. He was a noble fellow and a very thoughtful man; the only thing in which he failed was a capacity to work out things in their details. The result was that through the lack of some detail of his cannon it exploded and killed him. He told me that when he was calibring the machine-gun he did not know where to stop, and it resulted in his going on till he got to a breech-loading cannon. That has been my own experience, and that is the reason why I say what I am saying. The Admiral asks me to explain why I do not believe much in the fire of any arm beyond 1,000 yards. I shall offend all the artillerists here when I tell them I do not care very much for artillery fire. I said that to the Duke of Cambridge in 1869, when General Gambier was Chief of Artillery on the Duke of Cambridge's Staff. The Duke said to me, "Suppose I bring artillery fire against you." I looked over to General Gambier and said, "I do not care much for artillery." Well, that created quite a sensation. "You do not care much for artillery!" "No," I said, "it is a very good thing to frighten green soldiers with, but old soldiers do not care much about it." I said, "I have walked along the line when they have been firing 68 lb. shells over us, and the only trouble with our men was that they got too callous of them—they were too indifferent. If we heard a shell coming right straight for us we were in the habit of dropping on the ground and letting it pass over our heads." So I say I do not care very much for artillery. Man is an animal that adapts himself to circumstances, and so he adapts himself to artillery fire. It is one of the conditions under which he lives; he gets used to it, and does not care much about it. With reference to the guns exhibited, the two-barrel gun has fired about 20,000 shots before the Committee without a jam. When it was purposely designed to jam the guns, the Gatling and Nordenfelt were all successfully jammed, but my own guns resisted every attempt to jam. The one-barrelled gun fired 215 shots in a minute. Captain Bainbridge, I think, who had never fired a machine-gun before, fired 183 shots in a minute. Then a Staff artillerist—he was an old man with a good deal of endurance but not much activity—fired 300 shots in 1 minute 42 seconds, at the rate of 176 in a minute. We then took it to Enfield and it was tested for accuracy. It was objected, that owing to the lightness of the gun and mounting its fire would be inaccurate; but when it was fired at 1,000 yards the result was, as the members of

the Committee know, the gun made bull's-eyes when they could not see the target. Then the question naturally arose as to how the firing of this gun, with its little 28 lb. mounting, compared with the firing of a Snider rifle locked into its firm fixing, which firm fixing means a rock weighing two tons and an iron frame weighing half a ton more. Shortly after that I was at Woolwich. and I asked Captain Bainbridge, the Secretary of the Committee, how much superior the firing of the Snider rifle from a fixed rest was to the firing of my gun from the 28 lb. rest. "Well," he said, "your record is the best; I presume it is due to the system of rifling." It was quite a relief to me to understand that a 28 lb. rest gave a machine-gun greater accuracy than over two tons would give to a Snider rifle. The two-barrelled gun, as the Committee reports, showed an extreme capacity of 680 shots a minute, and it is the only gun that went through the trials without a jam. There is not a black mark against that gun in the whole series of trials, intended as they were to break every gun down.

The CHAIRMAN: I am sure we are exceedingly obliged to Mr. Gardner for his lecture.

Monday Evening, February 20, 1882.

VICE-ADMIRAL J. H. SELWYN, Member of Council, in the Chair.

BARKER'S SYSTEM OF FOG SIGNALS FOR OCEAN NAVIGATION.

By Captain W. B. BARKER, U. S. Mercantile Marine.

I BEG to thank the Council for permission to read a paper on my system of fog signalling by which to increase the safety of ocean navigation during foggy or dense weather.

In addressing a body of gentlemen like those present, so well versed in the dangers attendant on the navigation of broad seas or narrow waters during *fogs*, I need not expatiate upon the necessity of possessing some well-established method of informing others of, and receiving from them, approximate courses vessels are steering.

We possess in Maryatt's and Rodgers' signals means by which vessels of all nationalities can correspond during daylight and in bright sunshine. I now propose to show you how by my fog signalling apparatus the same vessels may hold converse during the gloomy, foggy hours of the day or night.

During the past year the vessels lost at sea averaged about one every four hours; a large proportion of these losses occurred from collisions, and mostly in fog or other darkness.

Steamers were involved in 400 collisions in 1879 and 1880 in the North Atlantic Ocean alone. Each of these might have been avoided if the master of one colliding vessel had been informed in proper time of the course pursued by the approaching one. This alone makes one vessel a day in which property was destroyed, and human life sacrificed. Most of the years of my life have been spent on the ocean, and my daily security has depended largely upon rules made vital by marine legislation.

The total tonnage of ocean-going vessels is about 14,000,000, of which the British share is some 10,000,000. British sailing-vessels number 18,000; British steamers number 4,000. Total ocean-going steamers afloat 7,000. Tonnage 7,500,000. Value of shipping at 25*l.* per ton, say, 325,000,000*l.*

The British exports and imports for last fiscal year amount to 1,024,815,000*l.*; most of the steamers making several cargoes each year.

It is safe to say that the yearly value affected by marine legislation will equal ten times the value of the shipping, or that each ship should carry each year cargoes equal to ten times its value, giving a total of 16,250,000,000 dollars. This amounts to three times the value of the

national debts of Great Britain and America, rating each at its maximum in any period of its history.

The total number of sailors afloat is about 2,000,000; passengers afloat daily about 2,000,000; 4,000,000 persons therefore to-day on the ocean ask the British Government to assist in introducing a system of fog signals which shall render human life more secure at sea, and twenty times that number on land repeat their request.

Often have I watched through the long night and the following day immersed in dense fog, every moment afraid lest some approaching vessel would come dashing into mine. My only chance of avoiding a collision was by hearing a fog horn, and by keeping clear of the vessel on which it was blown. I heard the horn, but I was compelled to conjecture upon what point of the compass my neighbour was steering—whether he was pointing east, west, north, or south, or at my own vessel. How was I to know? In "the rule of the road at "sea" there was no law by which I could tell him or he tell me the course pursued by either vessel.

In the collision, November, 1878, between the steamer "Pomera-"nia" and the barque "Moet Elion" both Captains were strictly complying with the nautical law; yet over 100 people went to the bottom. This occurred because the law does not direct the master mariner to announce the course of his vessel to an approaching ship.

When that terrible collision took place in the British Channel, I began to study the matter. I found that the calamity could have been avoided if either Captain in charge had known the course pursued by the other. In short, had either known what the other was doing, all would have been safe. This convinced me of the incompleteness of the present system of signalling.

Since that day, my time, energy, and private means have been devoted to remedy the difficulty. The result is my present system of *automatic fog signalling.*

I was convinced—1st, That no system was complete which did not give in a simple and certain manner the course pursued by every vessel in a fog.

2nd. That if a Captain of one ship knew in time the course of an approaching ship, he could put his own vessel in a position to avoid collision.

3rd. That the signal must be given by mechanism, and that the judgment of the person ordered to give the signal should be dispensed with as far as possible.

4th. That the giving of warning signals should be made compulsory by the laws governing vessels at sea.

5th. That when these propositions become actual law, ships on the ocean would be vastly more safe and the shipping interests more secure.

Sailors' Judgment.

In this matter I must appeal to the judgment of seamen and the sympathy of those who live ashore. I am constantly amused and surprised to see how easily and aptly those who have never lived at

sea can explain to me how to meet and avert dangers which beset the practical mariner.

I do not speak unkindly when I say landsmen are not competent advisers in such matters. Ingenuity is common to this age, and advice is cheap: but to render it valuable in marine matters, the person giving it must serve his time on deck amid wind, storm, darkness, and the confusion which prevails when the master of a ship must think of a hundred and do a score of things to assist, protect his ship and the people intrusted to his care.

With a dense condition of the atmosphere the sound of a fog horn is transmitted a much greater distance than when the air is rarefied. In the first condition a certain blast would indicate the distance of one mile; in the second, the same blast would indicate three-quarters of a mile or less. This is a deduction from the principle that solid is a good conductor of sound, and may be illustrated by transmitting sound through a rod to the ear, and comparing it with the rod removed half an inch from the ear. This, among many other conditions, must be carefully considered when we estimate rules and appliances needful to secure safety of vessels in fog at sea; and any adviser in fog signal matters must have experienced these difficulties before he can be called wise or safe.

Requirements of a fog-signal alarm are—simplicity, brevity, and the absence of doubt as to the meaning of the signal given.

1. *Simplicity.*—The language must be *universal*—must be understood in any language. To speak English to a Dutch Captain or Choctaw to a Chinaman would be as intelligible as chattering Hebrew to a French schoolboy. But every language has long and short sounds, and the most uncultured ear can distinguish between a long sound of five or ten seconds and a short sound of one second. To avoid any possible error as to length of sound I would make the long sound vibratory or broken, and the short sound a clear unbroken blast. Hence the only sounds used in a fog-signal should be a long, rough sound, and a short, smooth one. A method simpler than this I cannot imagine, nor do I believe intelligible movements of approaching vessels can be communicated in language less complicated.

2. *Brevity.*—In danger of collision in a fog, a master of a ship must be able to act *instantly*. He must know the situation of each vessel at the *moment* the signal is given, that every *second of time* may be used to put his vessel in the direction necessary to avoid collision. In this the two sounds meet the standard I have laid down. If any language is briefer or more intelligible I shall be glad to learn it.

3. *Absence of Doubt.*—Nothing can paralyze the master of a ship so much as doubt as to what direction his duty calls him. If he *hesitates*, he loses the confidence of his men. In moments of danger every man must do his duty with a conviction which controls his every energy. How can such energy be inspired unless the Captain knows what he is doing and why he is doing it? And how can a Captain act with *perfect* confidence unless he *perfectly* understands the signal from an approaching vessel, and that that signal tells him *beyond a doubt* what course she is steering, and what he must do to avoid her?

I therefore conclude that these two sounds may be understood by any Captain on the sea, that they are simple, brief, and will tell beyond any possibility of misunderstanding what course is being taken by one vessel, and how another vessel may steer to avoid collision.

How to Avoid Collision of Steamers Meeting or Crossing.

For this I know but one safe rule, viz., put your vessel in an opposite direction from that taken by the one you would avoid. If your neighbour is steering north, you must point south. If she is going west, you go east. If her course is north-east, put your vessel instantly south-west. Do not hesitate, doubt, or wait. Give one vessel the right of way and she holds steadily on her lawful course. The other must avoid her. If you know the course of your neighbour, one mile distant, and obey this rule promptly, you cannot collide in one case out of a million. This does not apply to vessels overhauling each other. To wait for your neighbour until you can see her and then depend upon chance or your ability to dodge her, is to invite destruction. That was just what the "Pomerania" did.

I advise *automatic machinery;* every signal should be given by machinery and not by a sailor's mouth applied to a fog horn.

1st. Because a man with a given horn will produce a different blast in quality or quantity of sound when he begins to blow, from what he will after he has been on this duty for a quarter or half-hour. His lung capacity will show signs of exhaustion, the blast will reach a shorter distance, and the note produced will probably be changed in its "pitch," or relation to the scale of sounds, as his strength becomes diminished.

This is so true that it is impossible for any man to give one note or sound of certain length upon any *horn* for any considerable time.

2nd. The signal must vary, if the judgment of the man is relied upon. He may give a signal for four or six seconds which should be only five seconds, and a signal of one second may be extended to two or three seconds. To give length of sound correctly, presupposes perfect judgment as to "time," which not one man in one million possesses.

3rd. A fog horn requires, for a certain note, a given volume of air projected with a given pressure per square inch.

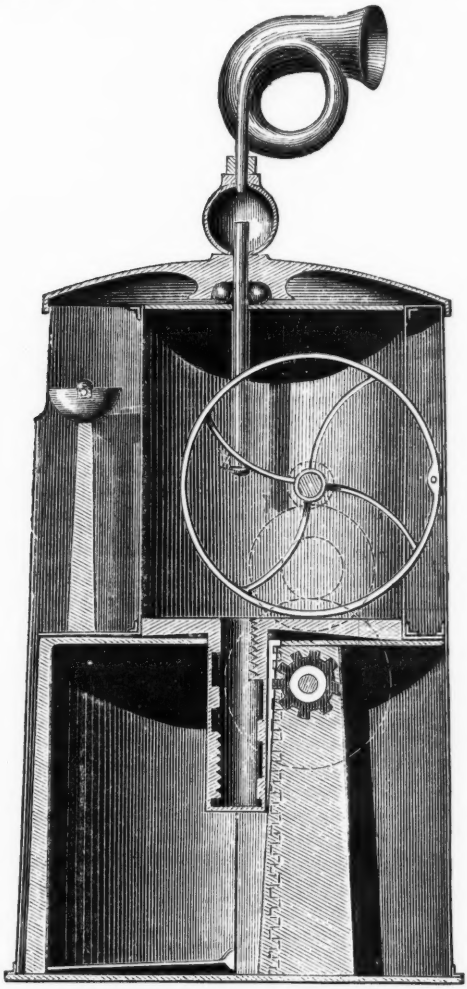
But a man with a large chest gives a greater volume of air than a small-chested man; moreover the force with which air is expelled depends upon the chest-muscles which pump the air through the horn.

No two men may be said to be equal in quantitative lung capacity, and no two men are equal in capacity to force air into a fog horn.

Even if men were equal in one respect they would not be in both; and if two men were equal in both these respects they would differ in their judgment as to the time required for a long sound or a short one, or the interval of time which should separate the two.

We therefore conclude, that the strength or weakness, or freshness or exhaustion of one man; the difference in size of chest of two men; the difference in the propulsive capacity of two men in their efforts

to fill a fog horn with air; the judgment of two men, or of one man, as to the time allotted to a given blast, or the judgment of one man,



or more men, as to the interval of time which should separate the sounds given by a signal horn; any one or more of these imperfections are fatal to the exactness required to render the fog signal with

sufficient certainty to remove all doubt from the mind of a master of a vessel for whom the signal is intended, and a signal which conveys doubt carries danger with it.

4th. A further objection to this system of rendering fog signals by mouth-horn arises from the fact, that the *distance* of a signalling vessel would be differently estimated according as the man blowing the horn was large or small chested, was strong or weak, or was fresh or exhausted. Half these objections, if sustained (and all of these must be apparent to you all), are fatal to any system of fog signalling. Hence my conclusion that signals *must be given by automatic machinery.*

My invention consists of a horn in the case of sailing vessels and a whistle in that of steamers, which emit a series of sounds in short and long blasts arranged in a simple and easily comprehended code. The new marine safety signalling machine consists of a cylinder, supported by four standards, in which a plunger works, while long and short clamps automatically cut the air into long and short blasts delivered through a horn. To operate the mechanism it is necessary to place the dial-plate to correspond with the compass course that is steered; then, by turning a crank, the air is compressed and automatically cut off into short and long blasts, thereby informing any vessel within hearing the course that is being taken. The dial plate is marked with the eight principal points of the compass, the remaining twenty-four being regarded as unnecessary, and only calculated to complicate and confuse the process of signalling. With this machine I have invented a code of signals, at once the simplest and most practical ever offered to the public.

The advantages of the machine are:—

1st. Every horn can be "timed" or set, or supplied with a reed which will produce a certain note, say "*C.*"

2nd. A machine will produce uniform pressure of air, which may be expressed by a given number of pounds to the square inch.

3rd. This will produce a note *invariable* as to quality or quantity of sound.

4th. The intervals between notes may be regulated with mathematical certainty.

5th. The interval of time separating each signal from the preceding one can be exactly determined.

6th. The long notes can be rendered *vibratory*, so that it is impossible to mistake them for short clear blasts.

A more modified form of the machine for small vessels has been constructed at a mere nominal expense, and is capable of giving any signal required for "fishing vessels," "yachts," &c.

Steam-Vessels.

The use of steam in propelling ocean-going vessels has greatly increased danger from collision. This is because some steam-vessels must make a rate of speed equal to five knots an hour to keep their engines in motion. This is emphatically true of the "Britannic," and other first-class steamships. Moving at this rate, it is essential

that the vessel which has the right of way should give an intelligible signal when she is not nearer than $1\frac{1}{2}$ miles from the vessel which is bound by law to get out of her way. At this distance any fog horn blown by a sailor is useless.

Human lungs may compress air with a force equal to a quarter of a pound to the square inch. This pressure will not produce a blast which can be heard at a distance sufficiently remote to insure movements of a ship needful to avoid collision.

With the same horn and mechanical compression of air to at *least* 6 lbs. to the square inch, the same will be carried much farther; and with a properly constructed fog horn and machinery to compress the air to 12 lbs. or 13 lbs. to the square inch, or for that matter 60 lbs., a vessel can clearly and distinctly tell its course to another vessel at a distance of from $1\frac{1}{2}$ to 2 miles.

My code, now known as the "Barker Code," can easily be made a well-understood language to sailors of every tongue and clime.

This code and the automatic machinery were brought before the American authorities, largely representing the shipping interests of that continent, with the following results (see Appendix).

APPENDIX.

National Board of Steam Navigation, New York, Sept. 16th, 1880.

"DEAR SIR,

"Your favor, dated Liverpool, 4th inst., to hand, and contents noted. In reply, "would say officially that Captain Wm. B. Barker's Marine Safety Signal Machine "was exhibited before this Board at its 9th Annual Meeting at Norfolk, Va., and for "five days was subjected to most critical examination by several hundred practical "owners, agents, and masters of steam-vessels, both as to mechanical and practical "operations, and was pronounced perfect. Among those who viewed it were a large "number of Officers of the United States Navy, Revenue Marine, and Life Saving "Service, who expressed themselves pleased not only with the simple mechanism "but the practical simplicity and effectiveness of the signal system adoption. The "eight signals given are quite sufficient for the purpose, and to lessen or increase "the number, is concluded on all sides, would be to impair the efficiency of the "system when put into universal use.

"I may say that, as a seaman, I have been deeply interested in the question of a "perfect and simple fog signal system; and as the Secretary of the Board which "represents the entire steam-vessel interest of the country, I only express the "opinion of this Board when I say, that the Barker system is by far the best yet "offered to the maritime public.

"The Board has referred the matter to its Committee on Inventions and "Improvements, who will report very favourably and forcibly upon its adoption by "the Mercantile Marine of the United States, and recommend its adoption also by "all the maritime Powers of the world.

"I have seen probably every system so far offered for public favour for fog "signalling at sea, but not one of them can be compared with Barker's for general, "as well as special approval.

"I am, dear Sir,

"Very truly yours,

"B. S. OSBON,

"*Corresponding Secretary N. B. of S.N.*

"GLADWYN JEBB, ESQ., Liverpool, Eng."

"We submit herewith the Report of the Board of Supervising Inspectors of "Steam-vessels in regard to this machine :—

"*Copy of Report of the Committee on Pilot Rules.*

"The joint Committee on Pilot Rules, to which was referred 'Barker's Marine "'Safety Signal,' submitted for the consideration of the Board, having the same "under consideration, respectfully report :—

"Having carefully examined the machine referred to, we find it to be an instru- "ment which cannot be too strongly recommended for use on steam-vessels.

"We are convinced that its use on *all* vessels navigating our oceans, sounds, bays, "and great lakes, would greatly reduce the dangers of collisions, not only during "foggy and hazy weather, but during the dark hours of night.

"The adoption of this instrument by all vessels navigating the waters referred to, "would enable the navigators of those vessels to determine the course of an "approaching vessel, however thick and foggy the weather may be, with such "accuracy as to make their navigation in a fog nearly, if not fully, as safe as in "broad daylight. The manner of determining the course of the approaching vessel in "a fog is by giving a certain code of signals which represent various points of the "compass.

"The machine is easily and readily adjusted, and is so simple in its operation that "no one with ordinary intelligence can fail to understand it.

"There is no doubt in our minds that the use of a code of signals, by all vessels "navigating at night or during foggy weather, would greatly diminish the dangers "of navigation ; but as our statutory law, while it does not in express terms prohibit, "does not delegate to this Board the authority to supply this much-needed and "long-felt want ; hence, until our present laws are changed or amended so as to "either prescribe a code of signals to determine the course of vessels at night or in "foggy weather, or delegate to this Board the authority to regulate fog and other "signals, we have *no authority* to approve the use of any machine for making signals "other than those *prescribed by law.*

"*For these reasons, however much we may be convinced of the utility of the "machine submitted for our consideration, its perfection, in every particular, and "its capacity for performing all that the interests of navigation demand, we cannot "recommend its approval, by this Board, for use on steam-vessels.*

"Respectfully submitted.

"JOHN FEHRENBATCH.
"GEO. S. NORTON.
"S. R. KIRBY.
"JOSEPH COOK.
"FRANK BURNETT."

"True copy,
"B. O. CARR,
"*Secretary Board Supervising Inspectors*
"*Steam-Vessels.*

"*Marine Signalling.*

"A Bill has recently been introduced in Congress in the United States of America "with the view of inaugurating an international system of course-steering signals to "meet the requirements of navigation during fogs. The Bill was introduced by the "Hon. W. W. Crapo, who is a large shipowner in the States, and is supported by the "National Board of Steam Navigation, which represents the entire shipping interest "of America, both inland and ocean navigation. The principles laid down in this "Bill are identical with those carried out in practice in Captain Barker's marine safety "signalling system, which we described and illustrated in our issue for September "30, 1881. We have just seen a letter from Captain B. S. Osbon, the Secretary of "the National Board, in which, referring both to the Bill in Congress and to "Captain Barker's system, he unreservedly states that were such a system to be "adopted by England, America would immediately follow with it. He also refers "to the high approval which has been given by the Board to Captain Barker's code "of fog signals and apparatus, and which is embodied in the following report, upon "which comment from us is needless :—

"'Washington, D. C., Oct. 5th, 1881.

"'Your Committee on Inventions and Improvements beg leave to report as follows

" ' upon the Barker Marine Safety Signal. It will be remembered that this signal
" ' machine was exhibited to the delegates to this Board at its annual meeting held
" ' at Norfolk, Va., Sept. 1st, 2nd, and 3rd, 1880, and received the general commen-
" ' dation from all present, for its simplicity of mechanism and effectiveness of
" ' action. One of its most valuable features was the signal code designed by
" ' Captain W. B. Barker, the inventor, which consisted of only eight signals,
" ' indicating certain points of the mariner's compass, which, being set to the index
" ' point, sounds the corresponding approximate course steered by the vessel carry-
" ' ing it, and thus gives warning to an approaching vessel, so that she may govern
" ' her movements accordingly. This machine, and its accompanying code, is
" ' designed for use on all classes of vessels navigating the ocean, and is beyond
" ' doubt the very best automatic fog signal ever offered to the maritime public. One
" ' that, so far as the mechanism is concerned, is enduring and not liable to get out
" ' of order. Its cost is very reasonable, while the system of compass signals given
" ' by the machine is so simple and easy of interpretation that it can be readily
" ' understood, and when the machine is set to the course being steered it will
" ' continue to sound the proper signal until the course and machine is altered to a
" ' different point of the compass. This machine has been exhibited before many of
" ' the leading owners and masters of vessels, both in this country and in Europe,
" ' and meets with an universal approval, and your Committee would earnestly
" ' recommend that some international action be taken towards the adoption of an
" ' automatic fog signal system, whereby all sea-going vessels be provided with
" ' automatic fog signal machines, which shall sound a signal indicating the approxi-
" ' mate course being steered by such vessels; and we further recommend that no
" ' signal code shall contain more than eight signals, each to be composed of not
" ' more than four blasts to each signal. And further, your Committee beg leave to
" ' say that in their opinion the Barker marine safety signal machine and code of
" ' signals, or some other equally as efficient and simple, is worthy of the highest
" ' recommendation of this Board as a system to prevent collisions at sea.

" ' B. S. OSBON, *Sec. N.B.S.N.*
" ' C. H. COPELAND, *Chief Engineer N.B.S.N.*' "

" *Marine Anti-Collision Inventions.*

" Two important inventions designed to prevent marine collisions in fog and on " dark nights have recently been perfected. One is the Marine Safety Signal—a " very simple machine, yielding very distinct blasts, either with the steam-whistle of " steam-driven vessels, or with the fog horn of sailing vessels. 'This system of " ' blasts,' says the "Maritime Register;" 'it is believed, will enable ships to " ' signal successfully from one to the other the approximate course each is steering, " ' and with such certainty and distinctness of tone that any vessel hearing will " ' understand the signal made.' The machine is worked by hand, and by means " of compressed air in a cylinder. The perfect simplicity of the apparatus is its " strong recommendation, and the Board of Supervising Inspectors of Steam " Vessels say:—' We find it to be an instrument which cannot be too strongly " ' recommended for use on steam-vessels, and are convinced that its use on all " ' vessels navigating our oceans, sounds, bays, and great lakes would greatly reduce " ' the dangers of collisions.' "—" New York Herald," June 20, 1880.

This system of signalling has been approved by the following owners and masters of vessels:—

Charles F. Elwell, President Maritime Association, Port of New York.
Edward Hincken, Esq., Shipowner, New York.
Ambrose Snow, Esq., Shipowner, New York.
F. Alexandre and Son, Havana Line Steamers, New York.
Captain E. Spicer, Mallory Line Steamers, New York.
Captain H. A. Borome, Old Dominion Line Steamers, New York.
Geo. W. Quintard, President New York and Charleston Line Steamers.
H. J. Bullay, Fort Canal Street, New York, General Superintendent for Pacific Mail.

Liverpool, August 16, 1881.

The foregoing system of signals for preventing collisions at sea is unanimously approved by the Council of the Mercantile Marine Service Association.

Captain Henry J. Ward, President; Captain Lister Harrison, Captain Charles Semple, Captain E. R. Peel, Captain Martin D. Hammil, Captain D. Anderson, Captain J. W. Darlington, Captain H. E. Bett, Captain W. Carr, Captain C. G. Grant, Captain A. Pearson, Captain T. J. Tobin, Captain J. Price, Vice-President.

Captain P. H. Colomb, R.N.: Not to lose time, I propose to commence the discussion. I always feel a little pity in my mind for lecturers in this Institution, when they come before the audience here with admirable plans and ideas, without perhaps having quite mastered what has gone before. It is now just twenty years since we had in this theatre an automatic siren signal, making long and short sounds in precisely the same way as we have heard them made to-night, not, of course, the same instrument, but the same principle, a series of long and short sounds with proper intervals between them, repeated in a revolving series so that they might be a continuous signal. That automatic signal that we had here formed part of my system, which was then young and struggling, which has now passed, as a matter of course, into every navy of the world, and the long and short sounds that we have heard to-night are the common every-day methods of signalling in nearly all the navies of the world the moment fog comes on. Fog does not appear for five minutes, covering an English fleet, before you hear from every ship the same long and short sounds, conveying the signals from the Admiral and back again to the ships. That a thing is not new, therefore, does not go to say that it is not true, because the lecturer's ideas tally very well with the ideas of those who are most familiar with the whole question. There is no question whatever that the long and short sound, the long and short flash, the long and short motion, the contrast of those two motions, forms the very best method of conveying intelligence that exists now or that probably will exist within the next century. We pass from that fact to the instruments necessary for making such signals. When I began to introduce my system into the Navy, the great difficulty of all was to get people to understand that it was exceedingly easy and exceedingly reliable. It was held to be excessively difficult and excessively unreliable. The consequence was that it was necessary to reduce it to the extreme of simplicity for practical purposes, and to surround it with safeguards so as to make errors impossible. Consequently everything that was done at first was automatically done. But the world has rolled round since those days. Some time ago the automatic arrangements for using the long and short flash by night fell gradually into disuse, simply because the skill and the quickened apprehension of the signalman supplied its place. I do not know now that there is anywhere automatic machinery employed for regulating the length of the sounds or flashes, and the intervals between them, and I am disposed to think that the time has come now, when the automatic regulation of those sounds may be left out of question. Such numbers of people are now accustomed to make these signals, and accustomed to hear them, that the manufacture of them, so to speak, becomes easy and very safe and certain. But, then, I quite agree with the lecturer, when he points out that for the purpose of making sound-signals the human lungs are simply useless. We must have very much more powerful machinery than human lungs given us to make our sounds go the proper distance. We have recently, in the Navy, introduced finally the steam siren. There is no question that sound has four or five times the capacity of the old steam-whistle. I have heard it come to me against a strong wind a mile distant quite distinctly, when the steam-whistle could not be heard a hundred yards in the same direction. That shows us that for the making of these sound-signals we must have proper machinery; we must have the power of getting the pressure of the air up, as the lecturer told us. In steamers where there is steam there is nothing so good now as the steam siren: it is altogether an admirable instrument and lends itself most easily to make long and short sounds. In sailing ships you have not steam available, and you must have some more powerful instrument than any human lungs will give

you. The orders, of course, are that such instruments are to be used on board ship. You are not supposed to use the fog-horns with the lungs for carrying out the regulations for avoiding collision at sea; you are supposed to use mechanical means to produce a sufficient sound. It strikes me that the instrument before us is very well calculated to do the work it has to do; and I do not see any objection to the automatic arrangement, although I am obliged to say, that as the world has rolled on, I do not see the same necessity for automatic arrangement which I did originally see. But, now, having settled the means by which the sounds are to be produced, and having settled whether we employ automatic machinery to regulate them, or whether we use the skill of the operator, the difficulty we come to is, what are we going to do with them in the particular case which the lecturer has put before us? That is to say, how are we going to use these signals for the purpose of avoiding collision in fog? To show how parallel my thoughts must have run with those of the lecturer, I may say that four years ago I put before the Board of Trade (and you will find it in the report of the Thames Traffic Committee) a proposal for making these course signals. It was not then at all a new idea. I had published proposals of that kind fifteen or sixteen years before, and many other people had also published them. It has been an old idea which is gradually germinating and coming to the front, and which will, I have no doubt, ultimately bear fruit. I have not the slightest atom of doubt about the practicability of it, nor about the usefulness of it, if it is properly carried out. In my proposal I did not go further than four course signals. I supposed that a ship would sound one signal from north to east including north, from east to south including east, from south to west including south, and from west to north including west. I supposed such directions would be sufficient, at any rate, to begin with; but, of course, if you could give me the means of knowing exactly how my opponent's head was, without confusing me or any other ship, I would very much rather that you gave me thirty-two signals while you were about it. As a beginning, however, I rather prefer, although I do not hold very strongly to it, confining ourselves to four signals. But there are great difficulties in the way—immense difficulties. There are difficulties in making these signals really useful if you have them. If, to-morrow, in a fog you knew how every ship was steering that you met, and if every ship was likewise so informed about you, I am almost afraid that I must say there is a possibility that there might be more collision and not less. And the reason is exceedingly plain. It follows from two grave errors which crept into the rule of the road in the year 1863, or thereabouts, and have stuck in it ever since, and when they will come out of it I do not quite know. Those two errors are very easily explained. Up to 1863 no seaman had the slightest doubt about what was meant by the words "give way." If he had any doubt he might have gone to the naval signal books—to the signal books, I may say, of all nations—and there he would have found laid down always in black and white, perfectly distinctly, "The ship that gives way is to pass under the "stern of the other ship," she is to "bear up and pass to leeward," she is to "pass under the stern." That is quite clear. There was never any doubt about it. In the year 1863, by some unhappy misfortune, I cannot tell you how it arose, the framers of the rule of the road at that date came to consider that the words "give "way" were misunderstood; further, they came to consider that it was a wrong direction to give a ship, to say to her that she was to "give way," if "give way" meant to pass under the stern. It was said, and it is said at the present day, that she has an equal right to try to cross the bows of the other ship. There is no mistake about that. It is laid down over and over again, and when I have endeavoured to combat it, I have found it quite impossible. It is laid down that you are not to make for the stern of a ship necessarily; it is open to you to consider whether you had not better make for her bows. There comes your difficulty in giving your course signals. If the ship that hears your course signal believes, as they do believe, that it is an open question to them whether they make for your bow or whether they make for your stern, I do not quite see what the advantage of your course signal can be. Then there is another difficulty. Up to the year 1863 no authority ever dreamt of saying to the ship which had the "right of way" (the expression which has been used by the lecturer and which is quite a legitimate and proper expresssion) "you shall keep your course." They said the exact contrary.

In papers that were circulated through the Navy, for the guidance of Naval Officers, in 1845, the Admiralty fathered a precisely opposite teaching, for these papers distinctly said, "The ship which has the right of way is *not to insist upon it*." It is the fundamental rule for avoiding collision that the ship which has the right of way is not to insist upon it; the law now is that she *is to insist upon it*, and there is no mistake whatever about that law. Again, if you receive a fog signal which shows you that you have the right of way, and that there is danger, you can only keep your course: you are not, lawfully, allowed to attempt to clear that danger. That is the law. Then, having those two difficulties to contend with, you have the further difficulty that in the last edition of the rules of the road you have already a system of sound-signals, which, when made upon a fog-horn, mean that the vessel is on a particular tack, but when made upon a steam-whistle means, "I am about "to direct my course to starboard," "I am about to direct my course to port," and so on—a very different signal. The only difference which at present exists between those two signals is what is called the *timbre* of the note, that is, you are supposed to know when you hear a steam-whistle, and to detect the steam-whistle from the fog-horn. Of course, one must anticipate, as time goes on, that the fog-horn on board ship may alter its tone—may alter its *timbre*, and be not different from the steam-whistle or the siren. I think that it is almost certain so soon as the siren becomes more completely understood, that even the lecturer himself will be putting a "siren" on the top of his instrument instead of the fog-horn, because he so gets a much louder sound, and then you are in that condition that the signals made by steamers to denote which way they are going to turn become the signals made by the sailing vessel to say which tack she is on, and there may only be that distinction between them. Then the fact that you have these signals of course makes it impossible to introduce further signals until those are swept away or modified in some degree. And as these rules are accepted by the whole of the European Powers, there is immense difficulty even in inducing the Board of Trade to move in the first instance. On the other hand, I hold quite distinctly and clearly that the lecturer is right that signals denoting the tack ought to be obsolete; and although I quite think we ought to have signals denoting which way you are going to turn and what you propose to do, yet the foundation of all these signals is such as the lecturer has put before you—a simple means of denoting the ship's course within, as he puts it, four points, or eight points, or two points, or whatever may be found most convenient. Then you must get your law right in order to make these signals really useful; but if you modify your present signals, if you get your law right, and if you introduce simple and efficient course signals, I am perfectly sure that the number of collisions will be very much modified.

Vice-Admiral NOLLOTH: What is the cost of the instrument? Has the distance been ascertained at which it can be heard; and, if so, under what circumstances of weather,—foggy, or clear? How many points can be indicated?

Mr. LAWRENCE: With reference to what Captain Colomb has just said, I do not know whether he understands that this system is applicable to the steam-whistle as well as to the fog-horn. (Captain COLOMB: Quite.)

Vice-Admiral NOLLOTH: In fog we have nothing but sound to trust to for a knowledge of the vicinity of another vessel, and, approximately, of her bearing from us, and I cannot but think that a mechanical speaker, such as that before us, would be the means of effecting a great saving of life and property, if of universal use. I think there can be little doubt of the superiority of automatic means over the living voice, not only on account of loudness, but for the several reasons so clearly set forth by the lecturer. But however clearly the course of one vessel may be signalled to another in a fog, safety must be always in a great degree a matter of chance, owing to ignorance of distance, speed, and exact bearing, as long as the vessels continue to run. We have been told that, during the past year, the vessels lost at sea averaged about one every four hours, and that a large proportion of these occurred from collisions, mostly in fog or other darkness. I suppose that, in these days of rigid demand for quick passages, many will not agree with me, but I have at times imagined that at some future day a more than ordinarily appalling catastrophe may lead to the adoption of stringent regulations regarding reduction of speed in much-frequented channels, and the stoppage of way,

as speedily as may be, on hearing the fog alarm ahead, with rules of conduct depending on the direction of the line of sound, and the relative positions of the vessels on the compass circle, if the respective courses have not been distinctly announced by siren, or other fog signal. Vessels are not so frequently meeting others in fog at sea, as to render the inconvenience of a little trouble and delay of such weight against an increased chance of avoiding so fearful a disaster as collision. Huge ships cannot be made to halt like a marching man, but the less speed the better if collision should occur, and Professor Holmes' siren fog-signal apparatus, it is said, "produces a sound capable of being heard a distance of from 15 to 25 "miles, according to the condition of the atmosphere." Sir R. Collinson informs me that he has heard Holmes' siren, under favourable circumstances, at the distance of 15 miles.

Captain COLOMB: I just wish to point out that the whole difficulty is in stopping. Unfortunately, there is no ship existing which can stop herself under five times her length if she is going at any speed, and generally it takes a great deal more.

Lieutenant CAMPBELL, R.N.: After the exhaustive review which Captain Colomb has made of the paper before us, there is very little to be said by one who is only an humble follower in his footsteps. Captain Colomb has been one of the pioneers of signalling in the Navy for more than twenty years; in this Institution he has read many papers and given many lectures which have established him as an authority, and therefore I wish to back everything that he has said. There is one point, however, which I would notice, and that is, that this seems to me to have a tendency towards educating the mercantile marine in signalling. Nobody who has not had a good deal to do at sea, knocking about amongst fleets and shipping of all kinds, would believe the absolute ignorance of all matters connected with signalling which exists in the mercantile marine. I mean particularly at night. Captain Colomb, many years ago, introduced a flashing system into the Navy, and I believe at this moment there is no merchant vessel in the world that can interchange a signal at night, though they may be in the most frightful danger; they may be off a lighthouse, or a coast where signalling would be very beneficial to them in making known their wants to the people on shore: but they cannot do it; they are absolutely unable to communicate by signalling, and therefore I think any code which tends to teach them signalling by sound in fog or by flashing lights at night, would be a great benefit to the merchant marine, and I certainly long to see the day when the International Code Signal Book, which is the finest signal book that ever was written, shall be universally used for night and fog signalling; but at present it is not numbered as well as lettered, and is therefore useless for this purpose. I do not know that there is any other point that I need refer to.

Captain COLOMB: I do not like speaking so much, but you must recollect that this is my subject. We must not altogether reproach the mercantile marine for their falling off in that way. The fact is that the Board of Trade were afraid of it and actually forbade it.

Captain BURGESS: I should like to ask the lecturer whether he has considered the question of adapting his plan of signals for fleets during the smoke of action.

The CHAIRMAN: I think the meeting will allow me to compliment Captain Barker on the extreme ingenuity and simplicity of his apparatus, and its applicability to the purposes of the mercantile marine in that it can be easily understood and worked. We rejoice so much in what Captain Colomb has done for us in the Navy, that we were, perhaps, apt a little to forget that there are still collisions, and that the mercantile marine is very ill-instructed in these things in all countries, and that they would no doubt welcome any encouragement given to them by the different Boards of Trade and Chambers of Commerce to adopt some plan by which they might communicate more easily with each other on general subjects. I observe that the lecturer, although he spoke of these compass signals as being useful in the first instance, in his new machine, as exhibited here, provides for an extended code of signalling, so that we may be able to converse with our neighbour at sea quite as freely as we are now accustomed to converse by means of the telephone in the City of London. There really would be no difficulty about it. It would be infinitely preferable that people should be able to give each other a courteous good day at sea than that they should run up against each other, and then indulge in most ob-

jurgatory diction, as I heard on an American liner lately. A young American lady who was there, hearing what was going on, asked if that was the language in which all maritime gentlemen indulged when they met each other on the ocean, she was so much impressed with its forcible character, although of course she did not understand it. Captain Barker has gone a long way towards making it almost impossible to make mistakes, and towards simplifying the apparatus so that it may be generally understood and easily worked. He will have to answer a question as to the cost asked by Admiral Nolloth. I have no doubt, had he known all that we know here in the Institution of Captain Colomb's labours, he would have mentioned that fact in the course of his lecture. These improvements grow up gradually, and we have not seen on board merchantmen generally, not even on board yachts, anything so perfectly adapted for ordinary work. There is a lamentable frequency of collisions even to-day which some means must be taken to avoid, and the lecturer did not dwell at all too strongly on the fearful increase of those collisions. Even in our own case, in the Navy of Great Britain, something is requisite to be done. In the smoke of action, which is another species of fog, generated by ourselves with the very slow-burning powder that we use, we shall have a necessity for some such thing in order to avoid collisions with our friends that may be quite as fatal as collisions with our foes. If naval actions are ever conducted on the principle of manœuvring, which has been so ably lectured on here by those who believe in it, we know that there must be a greater likelihood of collision without intending it, owing to the smoke, than has ever occurred before. I think those gentlemen who advocate, as Admiral Nolloth does, stopping whenever you are in danger, should go and try to do so once or twice and see how the owners like it. If I were to stop going up the narrows of Long Island Sound every time I heard a vessel in a fog near me I should never get to my journey's end in time to please the passengers, they would say that I was the most futile Captain they ever met with in their lives. There are many cases, too, in which it would be useless; for what with the drift of the current and the velocity of the ship, you would be just as likely to run into danger as to escape it by so doing. Sometimes when you are stopping somebody may come up astern: you cannot tell what you are doing. All the rules of the road strike me as having this in common—that they never provide for shoals or dangers on either side of you: they tell you what you are to do with unfailing regularity if you meet one ship, but not if you meet a thousand. Really the only advice anyone can give the sailor with any probability of his being able to follow it under all conditions is, "He cannot be wrong who keeps clear of another ship." That is the only advice you can expect him to follow. I may be close to a lee-shore. I cannot put down my helm in the way I ought to do, and it is quite possible that there may be shoals which the other man knows nothing about, but which I do. Under these circumstances these rules of the road become simply ineptitudes; and those are only correct who will trust to the educated eye and hand of a seaman steering him clear of difficulty and danger. Those who wish to lay down regular rules of the road will either find them ignored—which is, I think, rather more the case than people generally believe—or they will find that Captains positively take a pride, as some Captains do now, in going into another ship according to the law. That is very satisfactory, no doubt, to everybody concerned except the underwriters. It is the fashion to insure ships for pretty nearly their value, and so there is no great loss to the owners, and seamen care less for slight damage, so long as they escape such a collision as may be fatal to themselves; but the underwriters look at it with the greatest horror. I think, therefore, a seaman may say in such an Institution as this, that there is no rule of the road that will supersede in any manner the responsibility of the Captain or mate of the merchant ship who is on deck, that there must be instantaneous action; and while we admire all these advances and improvements in the means of obtaining rapidly valuable information, it must never be forgotten that you must rely at last entirely on the man's individual capacity, and that is the result, as Captain Barker has so well said, of a long training at sea. This makes it utterly and totally impossible for any wise rules to be originated or carried out by men who have never been at sea in their lives, except perhaps as passengers, and who know nothing of the difficulties to be met.

Captain SPICER: I have been in command of a vessel many years, and in refe-

rence to this signal I may say that going past Beachy Head—the Sovereign Shoal Light—you may sometimes in a fog find twenty steamers lying by at one time, all blowing their steam-whistles. My experience tells me the ear is the best regulator to say how the sound is going. You hear the signal west-south-west to starboard, and when you go to clear that man in a fog, you are just likely to run across the bows of another man close to you. This plan, to my mind, is very well in mid-ocean, but in narrow channels, where you have a bank on the starboard side of you and a gut running out the other side, it is almost an impossibility. And then the Chairman suggested that if you do not keep the vessel going, there is a tide-set, and you run against your will, whereas if you stop and go astern you get out of your course and lose your reckoning. Then again, what are you to do with a sailing ship stopping every time? You cannot keep the hands forward, to back the yards and all that sort of thing.

Captain BARKER, in reply to Captain Colomb's remarks with reference to vessels crossing or bearing up, said: The vessel that has the "right of way" of two sailing vessels is the vessel that is to leeward, and the other vessel must get out of the way, according to law. If the sailing vessel that is to windward passes across the bow of the vessel to leeward, and goes clear, it is all right; and if she bears up and goes under the stern, it is all right; but if she collides with the vessel which is to leeward, the law says she must pay damages. Prior to 1880 the sailing vessel claimed the right of way over the steamer, but it was also laid down by the "Rules of the Road "at Sea," that an Officer of any vessel in charge should use every precaution to prevent collision. I will call your attention to the case of the ship "Lady Octavia" and the steam-ship "Champion," which came into collision on the American coast. The "Lady Octavia" was steering east-north-east, and the "Champion" was running before the wind with her yards square. I admit there was no look-out. The steam-ship was an American. They were running along, making sail on the steamer. The man was taken off the look-out, and sent aloft to loose a sail. The "Lady "Octavia" came along with her yards braced up to catch the wind on her port side, and the chief Officer said that he could see both the red and the green light on the steamer on his port bow some five or eight minutes previous to the collision. Now, all he had to do was to luff his ship into the wind and prevent the collision. The law said he must use every precaution to prevent collision, but when he saw the steamer was determined to cross his bow, although the law gave him the right of way, I hold that he had no right to hold his course without making some kind of signal to the steamer. He should have fired a gun, burnt a rocket, or done something to attract the attention of the Officer of the steamer. Instead of that, he held his own, ran into the steamer, sank her, and lost thirty-five passengers in less than three minutes after she was struck. When I invented this machine, in 1878, my idea was this: that it would be of no practical value unless it was internationally adopted. I have had orders for it, I have had American shipowners asking for it, and can supply American lines of steamers. I have in my mind three or four different lines—Ward's line to Havannah, Joseph Alexander's line from New York to Havannah. Not a Captain in the White Star line but what approves of it. Several Captains in the Cunard line and in the Guion line approved of it; but if they were to ask me to-day for it, I could not sell it. I could not sell one to anybody unless the law says that on and after such a day every vessel must show the course they are steering in a fog; then when the English, American, and French vessels meet, they will speak a language each understands, and you will have no collision. I want to do away with the signals,—one blast on the starboard tack, two on the port tack, and three with the wind abaft the beam. I want to know if any one will take charge of that vessel on the diagram, and let me take charge of any one of those opposite, and then tell me how they are going to put the helm to get clear of me under the present system of signalling, that is, a sailing ship running sounding three blasts, showing that the wind is "abaft her beam." How am I to tell which beam it is? That is all I want to know: if you tell which beam, I will tell you how I will put my helm. The steam-ship owner has to pay for the loss of the sailing vessel simply because the sailing vessel is presumed to have the right of way. I do not think there is any justice in that, unless the sailing vessel is compelled to signal its course. Then as to the cost of the machine, the cost of these machines will never

exceed 15*l*. They will never be manufactured simply to supply one, two, or three to certain ships; if I make them at all it will be by the thousand, and then they will be made cheaply, and they will never be made so that they will not bear inspection. Then as to the distance at which the sound can be heard. This machine has stood on the "Adriatic's" deck at New York. In clear weather the sound was heard a mile across the North River and half a mile further in shore among the houses, but under ordinary circumstances that horn can be heard one mile; and assuming that it is only heard at one mile distant, if you let me know how a vessel is going to steer a mile off, I can clear her. The next question was, how many points I indicate. I can show you very clearly that I can tell within two points of the actual course the vessel is steering. To do that I only require eight signals. Captain Colomb spoke of four signals. I agree with what he said in every way, but I want to get a little closer to the course the vessel is steering. I can use my principle and only use his four signals, and tell within four points how the vessel is steering. But I want to get nearer than that. I have a system which can be read the same as reading 1, 2, 3, 4, or, say, the alphabet—a long and two short; a long and three short; long, short, and long; long, two short, and long. Any sailor can recollect that, and those are all the signals for the eastern side of the compass. I simply reverse these: two short, and one long; three short, and one long; short, long, and short; and four short. Now if my course is anywhere between north and north-east, I give a long and two short blasts; that means that the vessel is going north to north-east. I take the medium of these two, and any sailor hearing the long and two short blasts understands the vessel to be making the medium between north and north-east, which would be north-north-east. You can only be two points out of the way; if you are on the starboard bow of the vessel making the signal, you know within two points of her course; or if you are on the port bow you know within two points of her course; take the medium. North to north-east is four points; this signal covers it. But the actual course supposed to be steered is north-north-east, and that principle applies to every signal round the compass. Captain Burgess asked about the smoke in action. I spoke before about removing the bottom of this instrument, which is supposed to be a hollow tube, and made for the purpose of slipping signal codes up one after the other. That would be for the Admiral's ship, a signal meaning the same, but entirely different from the signals on the other vessels, so that nobody would be confused when the Admiral made his signal. Supposing he wanted to call attention to a certain ship, he would have an alarm signal or a signal calling attention, and he would have to spell that ship's name out with numbers. It would all be in the signal-book sufficient to count up to 9,999—he could name any number he wanted. We could make either the long blast of his signal vibratory, or we could devise some other means; but I believe in the distinction between *his* ship and any other; and I believe that in action sound is the only means by which you can with certainty convey the signals you desire. I do not see any other possible way of doing it in fog or smoke, although I have here a paper speaking of a system of signalling of Mr. George Reed, of the Royal Navy.[1] He has an indicator to be placed at the masthead, to show the course about to be steered, for preventing collision in clear weather. Of course, it would not work in a fog. I approve of it highly. It is an automatic signal, the semaphores being operated upon by the steering-gear.

Captain SPICER: Perhaps I may be allowed to mention that I live at Deal, and am well acquainted with Captain Reed, and I am very glad to endorse what has been said as to his system being one of the most beautiful modes of signalling that can be adopted. It is a semaphore, connected by steering-ropes with the steering-gear. When you steer to starboard up goes the green ball, and when you steer to port up goes the red ball. In the same way, on the main mast there is a green and a red flag, and at night-time there are two masthead lights working on the same principle, showing a red and a green light right ahead. It is one of the most beautiful things we have, but although used generally in the Navy, you cannot get it used in the mercantile service.

Captain BARKER: Any contrivance that will give information to those in charge of an approaching vessel as to your intended movements is of very great value. This

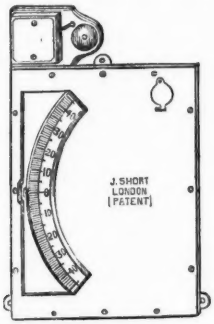
[1] See Journal, vol. xvi, No. LXIX, 1872.

invention of Mr. Reed's is for signalling in fair weather. This evening we have been dealing with fogs. Captain Spicer has said there are sometimes as many as twenty vessels lying together in the Channel, blowing their steam-whistles; it must be very difficult for them to keep clear of one another under the present system of signalling. They are there all sounding the same signal in a fog. What I want is to make those vessels, if possible, indicate to one another, before they get too close together, what they intend to do. There is a time when they are not too close together; to demonstrate that properly, I should have a board with models, and then I could show you what I mean. There is always a time when one vessel is away from a fleet; as she approaches a fleet of vessels she hears all this confusion, and instantly begins to get out of the way. With your present system of signalling she does not know whether they are not all going together just the same way that she is, and perhaps she runs into the lot.

The CHAIRMAN: I think you will agree with me that we must return our thanks to Captain Barker for his very lucid paper.

Mr. SHORT then explained his mercurial clinometer as follows:—

SHORT'S PATENT SHIP-CLINOMETER.[1]



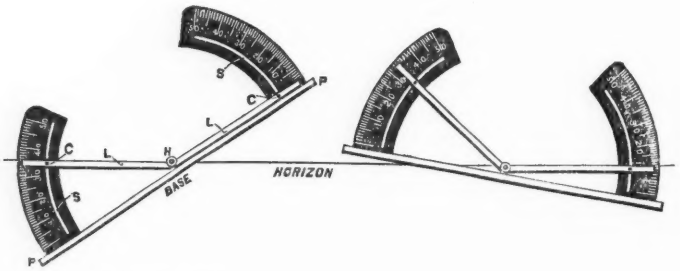
This instrument consists of a tubular ring of glass, iron, and vulcanite, partly filled with mercury and enclosed in a mahogany frame, the top of the column of mercury visible in the glass portion of the tubular ring rises or falls as the ship rolls, and shows against a scale graduated to 1°, the real angle of roll of the ship, the column of mercury and graduated scale being of a size that is easily read at ten or twelve yards distance, while the instrument is of a moderate size, about eighteen inches in height, and is fixed to a bulkhead or side of a cabin, as a picture would be on a wall. It is fitted to H.M.S. "Inflexible" and other ships of Her Majesty's Navy. During a seven months' trial on board H.M.S. "Minotaur" it was found to agree always with the reading of the rolling battens.

An electric apparatus has lately been added by which a signal from a bell is given when the ship reaches a dangerous roll.

[1] The illustration shows an electric clinometer, a specimen of which is deposited in the museum.

VICE-ADMIRAL NOLLOTH'S SHIP-CLINOMETER.[1]

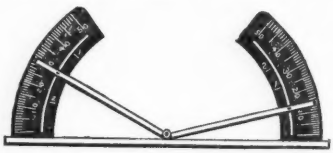
Vice-Admiral Nolloth repeated what he said here more than twenty years ago—that he had taken correctly with a carpenter's rule, the port or starboard roll of a brig in a heavy sea, off the Cape of Good Hope, when the pendulum was useless. He explained the use of a similarly simple instrument (see diagram), by which both port and starboard—the



Base, length 2 feet.
„ cross-section half-inch square.
Limbs, cross-section half-inch square.
H Hinge.
C Clamps.
L Limbs.
S Slot for transverse of clamp.
P Projections (metal) for securing to resting-place by twine or screws.
The scales are vulcanite.

whole roll—can be easily and accurately taken by one observer. It is to be placed (at right angles to the keel) on the taffrail, or bridge-rail, or any convenient place whence the horizon is visible, and which is parallel with the horizon when the ship is upright, as ascertained by plummet in harbour.

At night, or whenever convenient, any number of rolls can be taken and read off afterwards at leisure by marking on the vulcanite with a pipeclay pencil the angles observed, as at 1, 2, 3, which numbers distinguish the pairs of observations. Thus—



[1] The original instrument was shewn at the above Meeting.

NAMES OF MEMBERS who joined the Institution between the 1st January and 31st March, 1882.

LIFE MEMBERS.

Campbell, F. S., Capt. Royal Sussex Regt.
Kelly, W. F., Capt. Royal Sussex Regt.
Prickett, J. R., Lieut. R.N.
Rice, Ernest, Capt. R.N.
Noel, Hon. E., Capt. Rifle Brigade.
Cameron, M. A., Lieut. R.E.
Hay, A. E., Lieut. R.H.A.
Poore, Richard, Lieut., R.N.
Goodair, W. H., Lieut.-Col. 11th Lancashire Rifle Volunteers.
Chisholm-Batten, A. W., Lieut. R.N.
Maycock, S. M'M., Lieut. R.E.

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Donne, B. D. A., Lieut. Royal Sussex Regt.
Young, J. C., Lieut. Royal Sussex Regt.
Jocelyn, J. R. J., Capt. R.A.
Mount Charles, H. F., Earl of, Lieut. Scots Guards.
Walker, W. T., Major 3rd Midd. Rifles.
Scally, A. St. J., Lieut. Waterford Art. Militia.
Callaghan, G. A., Lieut. R.N.
Reay-Mackey, G. W., Esq., R.N.
Burder, J. W., Lieut. R.N.
Savile, Henry, Lieut. R.N.
Anson, A. H., Lieut. R.N.
Anson, W. V., Lieut. R.N.
Custance, S., Lieut. Duke of Cornwall's Light Infantry.
Maberly, E. F., Lieut. Duke of Cornwall's Light Infantry.
Hatherell, W. G., Lieut. Duke of Cornwall's Light Infantry.
Probyn, F. H., Lieut. 9th Bengal Cav.
Foster, J., Lieut. Grenadier Guards.
Smith, H. C., Lieut. Grenadier Guards.
Lewis, L. V., Lieut. Grenadier Guards.
Miller, A., Capt. 3rd Batt. Hampshire Regt.
Berendt, S. B., Capt. Yorkshire Art. Volunteers.
Favell, T. M., Lieut. Northumberland Art. Volunteers.
Callwell, C. E., Lieut. R.A.
Pfoundes, C. J. W., Esq., F.R.G.S., &c.
Haly, R. H. O'G., Major York and Lancashire Regiment.
Bainbridge, E., Major R.A.
Longley, A., Capt., A.P.D.
Buxton, H. E., Lieut.-Col. 2nd Norfolk Rifle Volunteers.
Angel, W. T., Capt. 8th Middlesex Rifle Volunteers.
Edwards, E. G., Lieut. R.H.A.
Monckton, P. E., Capt. R.A.
Wadd, H. C., Capt. London Rifle Brig.
Needham, Charles, Major 1st Life Gds.
Sandbach, A. E., Lieut. R.E.
Macneill, Robert, Capt. late 13th Hussars.
Loyd, L. V., Lieut. Grenadier Guards.
Thompson, C. W., Lieut. 7th Dragoon Guards.
Thring, F. J., Lieut. R.N.
Smith, S. B., Lieut. Worcestershire Regt.
Ferguson, J., Capt. Buchan Rifle Vols.
Mitchell, H. L., Major R.A.
Adair, W. T., Capt. R.M.L.I.
Baxter, J. C., Lieut. R.E.
Nugent, R.A., Dep.-A.-Com.-Gen. Com. and Trans. Staff.
Baden-Powell, W. S., Lieut. Royal Naval Artillery Volunteers.
Brooks, R. W., Capt. 1st Worcester Artillery Volunteers.
Fennell, C. J., Esq., R.N.
Ellice, E. C., Lieut. Grenadier Guards.
Herbert, F. A., Rear-Admiral.
Symes, E. Griffiths, Esq., late Adjutant-General's Office.
Manners, Lord, Lieut. Grenadier Gds.
Hancocks, A. T., Major late Worcester Militia.
Fitzgerald, Lord Frederick, Lieut. King's Royal Rifle Corps.
De Lisle, R. E., Lieut. R.N.

ERRATUM.

At page 895 of the last number is a note in which it is stated that 1 kilometre = $\frac{3}{5}$ English mile. This should read $\frac{5}{8}$ English mile.

OCCASIONAL PAPERS.

This portion of the Number is reserved for Articles, either Original or Compiled, on Professional Subjects connected with Foreign Naval and Military matters; also for Notices of Professional Books, either Foreign or English.

It is requested that communications or books for review may be addressed to Lieut.-Colonel Lonsdale Hale, at the Royal United Service Institution, Whitehall Yard, London, S.W.

PARTISAN WARFARE.

"Der kleine Krieg und seine Bedeutung für die Gegenwart" (Partisan Warfare and its Present Significance). By Lieut.-Colonel A. von Boguslawski. Berlin, 1881. Luckhardt, Pamph., pp. 88. Price 3*s*.

"De la Guerre de Partisans; son Passé, son Avenir" (Partisan Warfare; its Past and its Future). By A. Devaureix, Capitaine-Adjutant-Major au 135e de Ligne. Paris, 1881. Baudoin, Pamph., pp. 157. Price 2 fr. 50 c.

EVERY military student has a general notion of what the German means by "der kleine Krieg," what the Frenchman understands by "la petite guerre;" but when the Englishman comes to translate these expressions into his own language he will be at a loss to find a satisfactory equivalent. "Little war" will not do at all, because, though literally the correct rendering, it means quite a different thing. He will probably think of "minor operations of war" and of "minor tactics," but neither of these expressions will satisfy him, because neither "minor operations" nor "minor tactics," as understood by us, comprise all that the foreign terms are intended to convey.

On the whole I think that the title which I have put at the head of this paper is the nearest approximation to the original expression to be found in our tongue which, rich as it is in most respects, is singularly poor with reference to military phraseology, and I have the less hesitation in adopting this title for my article because the writer of an able essay in the French language, from which I shall borrow largely, practically treats "la petite guerre" as synonymous with "La Guerre de Partisans," the title which he gives to his work.

The former of the above-mentioned works must at once command respect from the professional reader on account of the author's well-deserved reputation as a military writer. It is founded upon two lectures delivered to the Military Society at Posen, and amounts only to a short essay, but though short, it is full of interesting and instructive matter, and will make every reader hope that the author will, ere long, treat this important subject in a more exhaustive manner.

M. Devaureix's work is the reprint of a series of articles which appeared in the "Journal des Sciences Militaires," and of which he promised us a continuation, which has unfortunately not appeared. It is very valuable on account of the large amount of historical information given in a condensed form, and

on account of the clearness and originality with which the writer places his views before us.

Definitions of Partisan Warfare.

Partisan warfare has been practised in all ages and by all nations with more or less effect, and many writers upon the art of war have attempted to define it; for instance—Valentini, Decker, Marshal Saxe, Bugeaud, De Brack, Rüstow.

I will give an abstract of Boguslawski's remarks upon the subject. A definition to be of any use must be both striking and exhaustive. This is, however, seldom the case with regard to matters relating to war, on account of their complicated nature, at least when you go beyond mere outward form. The Germans are much given to sifting and going to the bottom of things, which is highly commendable, but the practice is sometimes carried too far and lapses into pedantry without producing any practical result. A particularly mischievous practice is that of wrapping the subject of inquiry up, as is sometimes done, in a cloud of mystery which the select few alone can penetrate. On the contrary, military writers should endeavour to spread true ideas about war throughout the nation, and this can only be done by keeping to language in common use, and by abstaining as far as possible from professional cant.

The definitions hitherto given of "partisan warfare" are far from satisfactory. For instance, Valentini and Decker assign the duties of outposts, patrols, and reconnoitring parties in a lump to this department, but this is an error, for certain varieties only of these services should be thus classified. For instance, when, on the 15th August, 1870, Redern's Cavalry Brigade was detached from Rheinbaben's Division towards the Metz-Verdun road, the former again sent forward squadrons to secure itself against surprise and to reconnoitre, which squadrons fell upon the flanking parties and advanced posts of the French General Forton's Cavalry Division, the immediate result being some skirmishing and a cannonade, which caused the concentration of two cavalry divisions on the French side and of thirty-four squadrons on the Prussian side. On this occasion the squadrons first engaged cannot fairly be said to have been performing an operation of "partisan warfare," seeing that this operation was carried on in immediate connection with the movements of the two main armies, which were on the march and not far apart. On the other hand, the cavalry divisions and mixed detachments employed in covering the siege of Paris, and, later on, those engaged during the pauses which now and then interrupted the great operations on the Loir, about Le Mans, and elsewhere, were certainly engaged in "partisan warfare," as they were completely detached for the time from the main armies, and were carrying out operations independent in themselves, although in accordance with the general plan of the supreme authority.

In fact, two detachments may be sent out to perform exactly similar duties but under different circumstances, when one of these parties will be performing an act of "partisan warfare" but not so the other. The distinction may at first sight appear merely nominal and of no practical importance, but such is not really the case because, as we shall see further on, the two detachments will, in consequence of the different military situations in which they are placed, perform their similar duties in a different manner. To make the distinction between "great operations" and "partisan warfare" depend upon the strength of the force employed would be still more erroneous, as a very considerable force may be engaged in "partisan warfare" on one occasion and a comparatively small one in "great operations" on another. The same remark would apply if we were only to take into consideration the distance which separates a detachment from the main body of the army.

As a consequence of these reflections Boguslawski renounces the idea of giving any general definition of "der kleine Krieg," and proceeds to point out some of its distinguishing features, its general characteristics, and the objects which may be gained by it, as the best way of making the reader define it to his own mind. These objects are—

1. To gain intelligence of the enemy.
2. To guard against surprise.
3. To hold the enemy in play.
4. To harass the enemy as much as possible without compromising the existence of the detachment employed.
5. To continue resistance against an invader in a province occupied by him.

Outpost and reconnoitring duties are included under the first two headings with the reservations above given.

Under the third heading may be included both the execution of feints and the action of independent bodies detached for the purpose of diverting the enemy's attention.

The greatest variety of operations is included under the fourth head, comprising, as it does, isolated enterprises during the pauses which sometimes interrupt the great operations, together with the action of detachments against the flank and rear of an enemy, to do him the utmost possible harm, to keep him in a state of constant alarm, and, above all, to interrupt and damage his communications; the American raids for instance.

In taking the fifth object into consideration, we must imagine an invader to have occupied one or more provinces, making it incumbent on the defender not only to threaten his flanks and rear to the utmost, but also to make the public at home and abroad believe that the provinces in question are not really subdued. Such a situation, for instance, existed in 1807 in Silesia when Napoleon advanced to the Vistula, and the Prussians, based on the mountains of Upper Silesia, carried on "partisan warfare" in that province to the best of their ability. Such acts must often, in order to gain the end in view, be combined with armed resistance on the part of the civil population.

One distinguishing feature of "partisan warfare" is the great comparative independence of action allowed to the leader of a body thus employed, an independence which, under the circumstances of the particular service, is evidently indispensable.

Historical Retrospect.

Partisan warfare has been carried on from the earliest times, and in all parts of the world, but we need not, in our retrospect, go further back than the seventeenth century. We will commence with the Thirty Years' War, during which it happened over and over again that whilst the two main armies lay inactive in fortified positions or in cantonments, partisan warfare was carried on vigorously. Christian of Brunswick, Ernest of Mansfeld, and others raised whole corps by the promise of booty, fought a little, murdered and plundered a great deal. Their action, however, had but little direct effect upon the result of the war, as the armies of those days were not so sensitive to their attacks as those of later times, for, being comparatively small and easy to subsist, they, to a great extent, lived on the country, depending but little upon magazines and caring little for their communications.

Gustavus Adolphus, indeed, introduced a new order of things, and conducted war in a more scientific and methodical manner than any of his contemporaries, with much more regard also to humanity.

He, therefore, was not satisfied, like his opponents, to live from hand to mouth, and upon the resources of the wretched inhabitants of the theatre of war; on the contrary, he made arrangements to keep his army supplied from

a base of operations; hence his line of communications become a vulnerable point, but his small army (18,000 men on first landing) required no very large convoys, and being composed of first-rate material under excellent discipline, moved rapidly and in compact array, offering but few opportunities to the partisan leaders, who were little inclined to trouble him, and preferred the safer task of pillaging defenceless farms and villages.

Condé and Turenne carried to greater perfection the system introduced by Gustavus Adolphus, and war become more and more methodical; armies became more and more dependent upon their communications, and, therefore, there was a larger field for partisan warfare, particularly as the communications were as a rule badly guarded. The armies of Louis XIV suffered much from the attacks of partisans, and in consequence that Sovereign ordered similar corps to be formed with whom dragoons (mounted infantry) were combined. These corps continued to rise in public estimation, and during the latter years of Louis' reign young men of the highest families in France sought the honour of serving in them. Elsewhere, at that time, partisan warfare was but little practised except by the light troops and Croats of Austria.

It is well known how much Frederick the Great at first felt the want of light troops in his wars with Austria. In 1745 he was obliged to evacuate Bohemia, all his lines of communication having been interrupted by the Austrian cavalry and partisans, in consequence of which his army remained for a month without news of the outer world, entirely cut off from all support and in danger of famine. Yet that army was more than a match for anything that could be opposed to it in actual battle.

In the same way the French armies under Marshals Broglie and Belle-Isle were seriously harassed in their retreat from Bohemia in 1742. The former General had 22,000 men with him at Prague, and lost 13,000 of this force in marching from that town to Eger, all of whom were taken or dispersed by the enemy's partisans, for the latter were no longer like their predecessors, the robber bands of the Thirty Years' War, but daring and well-handled troops, acting under general direction for a common object, and not afraid to encounter the best regular troops under circumstances favourable to themselves.

Frederick the Great, speaking of this matter in his memoir, says, "When foraging parties were sent out it was necessary, in order to prevent them from being destroyed, to detach bodies of 3,000 cavalry and 7,000 or 8,000 infantry for their protection. Every truss of straw cost blood."

This lesson was not lost upon Frederick, who organized free battalions—jäger and hussars—to hold the enemy's partisans in check, placing at the head of these levies picked Officers, many of whom became most distinguished. Whilst all this was going on a remarkable Officer and an able administrator was serving France. Marshal Saxe appears to have been the first General in that country who thoroughly appreciated the value of partisan warfare. He had been an eye-witness of the distress of the French armies in Bohemia, and immediately after his return organized a corps of Polish lancers and the famous legion of Grassin, composed of both cavalry and infantry, whose special mission was to cover the army, both on the line of march and when in bivouac. This legion rendered important services, particularly in the campaigns from 1744 to 1748. Many other similar troops were formed about that time upon the same model.

During the Seven Years' War (1756–63) the partisan corps both of Austria and Prussia were as active as ever. When the war broke out similar levies were raised in France, and some of them rendered good service, but their efficiency, as well as that of the regular army, was much diminished by bad generalship and a general falling off of military spirit. In 1759, Marshal Broglie reorganized the free corps, attaching them to the different infantry

regiments, each battalion receiving a company, the origin, doubtless, of the "light companies," afterwards introduced under various names into most of the European armies.

Thus we see that by the middle of the eighteenth century partisan warfare was practised by all the principal Continental armies, that its object had become much better understood, that it was conducted in a much more systematic manner, and that those who had engaged in it had risen much in public estimation, the prejudices which naturally existed against the free corps of the Thirty Years' War not being entertained against their successors.

During the twenty-six years between the peace of Hubertsburg and the French Revolution, there is nothing remarkable in the history of partisan warfare in Europe. When the great struggle commenced which did not terminate till 1815, the principal European armies were in a very torpid state. Pedantry, routine, and a blind adherence to the letter, but not to the spirit of the system of tactics introduced by the Great Frederick prevailed everywhere. In France, however, the great convulsion which disturbed everything else overthrew also old military traditions. The old army had ceased to exist. The new levies, composed chiefly of raw untrained volunteers with plenty of zeal, but with little discipline, were quite incapable of taking the precautions necessary to guard against surprises, and whenever thrown upon their own resources in this respect, met with serious disaster, but from the very commencement of the war, the National Assembly had decreed the creation of free battalions called legions. Such were the legions of the North, of the Ardennes, of the Rhine, recruited partly from the cadres of the old Royal Army, and of the Swiss regiments which had been disbanded.

These partisans did good service in protecting from surprise the untrained troops of the regular army, and were used to perform all outpost and reconnaissance duty. Unfortunately, the rage for partisan corps became excessive, and their number became very great, attracting as they did many to their ranks, both from the prestige of the Service, and from the desire to avoid the restraint of the comparatively rigid discipline enforced in the regular army. However, men like Kleber, Desaix, and Ney knew how to make the best use of them, and to keep them in tolerable order. Whilst the Republican armies were defending the fortresses of France against the foreign invader, a civil war broke out in the heart of the country, which lasted seven years, and was maintained on one side at least entirely by partisans. The Vendeans were favoured in this respect by the nature of their country; otherwise they would not have been able to maintain themselves as they did against regular troops. Their chiefs, however, such as Charette, La Rochejaquelain, and Bonchamp were in advance of their age in the use of extended order for infantry, and it required a soldier of genius like Hoche to crush them. He did so by recognizing the necessity of fighting them with their own weapons, opposing to them light corps with tactics similar to their own, and with the advantage of more systematic control and direction. He covered La Vendée with a regular network of flying columns acting in combination, which drove the insurgents from point to point, finally forcing them to lay down their arms. Hoche's troops gained great experience in this work, and afterwards distinguished themselves on other fields against the foreign enemy. In 1794 Dugommier's troops had plenty of practice in mountain warfare in the Pyrenees, and the "Legion des Allobroges" there gained great renown as partisans. Both Marmont and Napoleon speak of them as being amongst the best troops of the army of Italy. When the other European armies disbanded their light troops, Austria maintained her hussars and Croats, and in 1792 brought into play on the Rhine some very good light troops, such as the Tyrolese Sharpshooters, and the "Wolfjäger," good shots and excellent skirmishers. General Marceaux was killed by one of them whilst reconnoitring.

The Prussian Army did not at that time make much use of partisans, but

there were some brilliant exceptions to this rule, particularly in the case of Blücher, then Colonel of Hussars, who in 1793 and 1794 performed some wonderful feats worthy of study by the partisan leader.

Partisan warfare was carried on vigorously by both sides in Moreau's celebrated campaign against the Archduke Charles in 1796, particularly during the retreat of the first-named General, when his army suffered severely both from the attacks of partisan corps, and of the armed peasantry. His own free corps were of great use in covering his retreat.

In the Italian campaigns of 1796-97, the Austrian Hussars maintained their old reputation, and surprised French troops on several occasions, Napoleon himself being once nearly captured by them at Valeggio, but his army was more seriously threatened by the free companies composed of escaped Austrian prisoners, Piedmontese deserters, and discharged soldiers, who infested the roads leading to the front through Genoa, Savona, and Nice. A detachment of 150 French soldiers was cut to pieces at Arquata. Convoys were frequently attacked. Many murders were committed in rear of the army. In short, though the fate of the war was not affected by the acts of these partisans, Napoleon's correspondence shows how much embarrassment they caused him; but it was in Tyrol that he suffered most from this sort of warfare, the whole population being in arms against him, and many of them formed into free companies, whom the nature of the country and the skill of the inhabitants in the use of firearms made singularly formidable. Napoleon's proclamation issued at Brescia ends with the following passage, which is sufficient evidence of the estimation in which he held these mountaineers :

" The villages whose free companies have not returned to their homes at our arrival will be burnt ; the inhabitants will be kept as hostages, and sent to France. When a village has submitted, the Syndics will be required to hand in at once a list of the inhabitants who are in the Emperor's pay, and if they belong to the Tyrolese free companies, their houses will be burnt, and their relations down to the third degree will be taken away as hostages. Every Tyrolese belonging to a free company who may be taken in arms will be immediately shot."

In 1797 took place the great Veronese insurrection, when 30,000 peasants having been secretly armed by Austrian emissaries, fell upon all French detachments and convoys, and committed great havoc.

In 1799 the French armies in Switzerland met with considerable resistance on the part of the armed peasantry, their lines of communication being seriously threatened.

By this time, however, a French army was no longer dependent upon special corps of light troops for protection against surprise, or against the enterprises of partisans, for thanks to the uniformity in training which had been established, the greater part of the cavalry, and nearly all the infantry, were fit for operations hitherto reserved for special levies, as well as for fighting in masses. In consequence of this, and also of the Napoleonic system of living on the enemy's country, and thus to a great extent dispensing with magazines and convoys, there was comparatively little opening for the action of partisans on the part of the enemy. Until, therefore, the ravages of successive wars had reduced the resources of the countries in which Napoleon fought, and until his armies became so huge, that in any case vast supplies were necessarily brought from the rear for their maintenance, partisan warfare remained comparatively in abeyance, except when the French ventured into countries like the Tyrol or Spain, where the resistance was national, and where the nature of the country peculiarly favoured the enterprises of partisans (Hofer's gallant stand in 1809–10—Spanish guerillas, 1807–14).

The British Army in the Peninsula had rarely occasion to engage in partisan warfare, work of this sort being done for them by their Spanish and Portu-

guese allies, and the British Army being the only force which could be depended upon for great operations, but there are two great instances of genuine partisan warfare on a larger scale, with which it may be credited. I refer to the surprise of Almaraz in May, 1812, by Hill, with 6,000 men of all arms,[1] and of that of Arroyo Molines by the same General in October, 1811.[2]

The Russian War furnishes us with an example of partisan warfare, carried on by men who were on the whole more formidable than the Spanish guerillas, but there was this great difference between them, that the Spanish bands were composed mainly of civilians, whilst the Russian partisans were almost all soldiers—Cossacks. The Russian peasantry took no part in this war, but from first to last the Cossacks were most enterprising and annoying to the invader.

We see from Napoleon's correspondence, when still on the advance to Moscow, how apprehensive he was for his long line of communication, and how much he had already been annoyed by the Cossacks. On one occasion he writes to Berthier, "You will tell the Duc d'Elchingen that he loses daily more than he would in a battle; that it is therefore necessary to manage the foraging better, and not to let the foragers go so far from the main body." Flying columns were organized to protect the communications, and chosen Officers were told off to form ambuscades for the venturesome Russians. But these enterprises were not effectively interrupted, and we find Murat, in command of the advanced guard, writing on the 25th September, that his men are greatly reduced by hunger, that they cannot go out to forage without great risk of being captured, and that he loses every day above 200 men in this manner.

Of course, matters became much worse when the retreat commenced.

"The enemy," says the 29th Bulletin, "surrounded all our columns with his Cossacks, who, like the Arabs of the desert, carried off our convoys and carriages which got separated from the main body. This contemptible cavalry, which only makes a noise, and would be unable to break a company of infantry, renders itself formidable from the nature of the circumstances." The greater part of the French loss in this fearful retreat was attributable to this "contemptible cavalry," the fame of whose deeds, much exaggerated, soon spread over Europe.

The lessons of the Russian War were not forgotten by Napoleon's enemies, and both Russia and Prussia organized partisan warfare on a very large scale, the Prussians especially proceeding, with the method for which they have since become so noted, to frame distinct instructions for regulating it. Many were the exploits performed by these bands in 1813. For instance, Thielmann, with a corps of 500 men, forced two towns occupied by French troops to capitulate (Nuremburg and Merseburg); a body of 200 Cossacks, under Tchermischoff, occupied Hamburg, and sank a number of gunboats, afterwards capturing all the remounts for the French cavalry. The Prussian Colonel made a dash at Zwickara, where he captured a convoy of 24 guns, 46 wagons, and 300 men. All these feats were performed, be it remembered, far in rear of the main army of Napoleon. Under these circumstances, convoys required very large escorts, and all the posts on the lines of communication required strong garrisons; consequently the fighting strength of the army was much reduced.

Napoleon endeavoured to remedy this state of things by organizing flying columns under command of intelligent Officers, to protect his lines of communication, and by forming four large partisan corps, each under a Brigadier-General, with instructions to clear the way for the main army, and to guard it

[1] See "Napier's History of the Peninsular War," Book xvii, chap. 1.
[2] See "Napier's History of the Peninsular War," Book xv, chap. 4.

against the enemy's bands, but these measures were of little avail, and French detachments continued to be surprised and overwhelmed as before. This was owing no doubt in great measure to lassitude on the part of many of the Officers, and to inexperience and want of stability on the part of the conscripts who now filled the ranks. The army was in fact much demoralized. Many more instances of successful attacks by the allied partisans might be given, but enough has been said to show how much the French Army suffered on its retreat to the Rhine.

When the allies invaded France in 1814, their partisans, particularly the Cossacks, tried to carry on the same proceedings as heretofore, but with much less success in a country where the inhabitants generally were against them. Still the remembrance of what they had done in Prussia and Germany had a strong moral effect upon the French, who particularly dreaded "les Cosaques," so much so that Napoleon several times complained that his staff were afraid to convey despatches lest they should fall into the hands of these horsemen. The French Emperor wished to employ against the invaders the same means which had proved so annoying to his armies on the other side of the Rhine, and on the 1st January, 1814, gave instructions for the formation of strong partisan corps (what he calls "une organisation d'insurrection") in each of his four armies under a General and several field Officers, chosen as far as possible from men well known and popular in the district where they were to act. These Officers were to organize the "levée en masse" for action against the invaders' communications. Few of Napoleon's Generals in 1814, however, cared to carry on a "guerre à outrance" and the country generally was too exhausted by its gigantic efforts to answer to the call of their sovereign; consequently but little was done.

In 1815 this idea of forming partisan corps again occurred to Napoleon, and he decreed that each of the frontier departments should raise a body of 1,000 infantry and 300 cavalry for this service. To stimulate their zeal, rewards were promised them for the capture of their enemies, ranging from 4,000 francs for a Lieutenant-General to 30 francs for a private. The campaign was, however, too short for these schemes to produce any effect.

The next time that we find partisan warfare carried on in Europe was during the insurrection in La Vendée, in 1832. Small flying columns were formed for its suppression, and the war was carried on much in the same way as by Hoche, in 1795, only on a smaller scale. St. Arnaud, then a Sub-Lieutenant, commanded one of the columns, and gives an interesting description of the operations against the Chouans in the first volume of his letters.

A good deal of the fighting which took place between the Christinos and the Carlists, from 1834 to 1839, was of the nature of partisan warfare. Again in Hungary in 1848 and 1849 we find instances of it in which the Hungarian Benitzky particularly distinguished himself.

In 1859 Garibaldi was very active with his partisans in the mountainous country to the north, and on the left of the allied armies, but was only saved from disaster by the victory of Magenta. The Crimean War, consisting as it did almost entirely of a siege, gave no opening for partisan warfare, which was, however, carried on actively by the Polish insurgents in 1863, many of them being only armed with scythes, notwithstanding which they often attacked Russian regular troops with success.

In 1864 there were several instructive examples of partisan warfare afforded us by the Danes and by the Prussians, but as they were mere isolated cases, and as some of them will be described more minutely in a subsequent section of this paper, I will say nothing further about them at present.

The great War of Secession from 1861 to 1865 is rich in examples of this nature. Never was partisan warfare carried on by the horsemen of a civilized nation on so large a scale and in so dashing a manner as both by Northerners and Southerners, particularly by the latter, and the names of Morgan,

Stuart, and Jackson on one side, of Pleasanton, Grierson, Stoneman and Sheridan on the other, will always recall the deeds of great partisan leaders.

In one of his celebrated raids, Stuart, with raw cavalry, or rather mounted infantry, and a battery, marched in three days 150 miles, going completely round MacClellan's army, breaking up railways and destroying depôts, and returning to his quarters with the loss of only five men. The Federal Pleasanton was despatched to cut him off at the head of a large force of cavalry, but did not succeed, though he marched at the rate of 55 miles a day. Many other instances of the same kind might be quoted.

The French have had considerable experience of partisan warfare in Algeria, and in their Mexican campaign, where the natives acting as guerillas gave them a great deal of trouble, and forced them to form partisan corps consisting partly of their own regulars and partly of foreign volunteers. Some very bad characters got into these corps, and the discipline was very loose, in consequence of which excesses were committed which served to increase the exasperation of the natives against the French, and led to the fearful reprisals which filled the world with horror. We find no instance of partisan warfare in the short campaign of 1866. Had it, however, been renewed after the truce, we should doubtless have heard of Austrian partisan corps acting on the Prussian communications, as the formation of such bands was decided upon, and probably of a Hungarian legion raised to aid the Prussians. And now we come to the war of 1870-71, of which I shall speak but briefly, as I intend to describe further on in greater detail some of the most remarkable enterprises executed by partisans during the campaign.

On the German side, partisan warfare was carried on as a matter of course only by regular troops, and principally by the cavalry, sometimes with the assistance of infantry transported in carts.

The independent cavalry divisions, and particularly their advanced parties, performed some genuine operations of this nature, on the Loire and Loir, and again in the north. One mounted detachment, for instance, made a sudden dash at Souchez, behind Arras, and captured 150 French soldiers, who being 25 miles in rear of the outposts, thought themselves in perfect security.

There was naturally a much greater opening for partisan warfare on the part of the French than on that of the Germans, and we find it carried on by the regulars to some extent, but in a far greater degree by irregulars and civilians.

During the siege of Metz, several "free companies" were formed in the beleaguered army, and these were employed chiefly in beating up the enemy's quarters at night and patrolling beyond the outposts. One of the most remarkable attempts was that made by a detachment from one of the free companies in an armour-clad railway carriage attached to an engine, intended to proceed at full speed to Courcelles to seize a German provision train known to be there, and to bring it bodily into Metz. This railway sortie was executed under cover of a considerable force which was intended to occupy Peltre and the environs, whilst the detachment of partisans under Captain Marchand proceeded to Courcelles. The attempt failed, however, as the Germans, having previous notice thereof, had broken up the line. Captain Marchand's detachment seems to have shown great vigour, and made its way back with some prisoners.

It was, however, during the second part of the war that the French partisans displayed the greatest activity. It was then, too, that the Germans were most vulnerable, on account of the great length of their lines of communication, and of their having to depend mainly upon a few lines of railway for bringing up supplies and reinforcements. Had they not been strong enough to spare large bodies of troops for guarding their lines, it would have been impossible for their armies to maintain their forward positions as they did. As it was, however, their communications were so much

interrupted towards the end of December, 1870, and in January, 1871, by enterprises of which more will be said further on, that had the war continued they would have been seriously hampered.

There is no doubt also that had partisan warfare been carried on by the French in a more systematic manner, much greater results would have been obtained. All honour to the vigour and pluck of those at the head of the French Government and who directed military affairs at that time, but their military experience and knowledge did not equal their zeal; there was a want of unity of action which showed itself in the mode in which partisan warfare was conducted quite as much as in great operations. The composition of the bands was, moreover, defective, there not being a sufficient number of old Officers and soldiers amongst them, and only a comparatively small portion of the able-bodied peasants being available, so many of them having been drafted into the Army. Garibaldi's corps disappointed expectation, though, as we shall see later on, it did some good work. It laboured under the disadvantage of not being popular with the peasantry, partly on account of their prejudice against the Garibaldians as foreigners, and partly because the latter were hateful to the priests, who denounced them as Atheists. Thus Garibaldi and his followers did not meet with the assistance which they had a right to expect from the people whom they came to assist, assistance so valuable to a partisan leader. Whatever, however, may have been the failings of the French partisans in their tactics, or of the French nation in its support of the Army, there is no doubt as to the sensitiveness of the Germans on the subject. Their cavalry, which at the beginning of the war behaved in such an audacious manner, pushing forward small detachments into the midst of large towns far away from all support, were in later days constrained to much greater circumspection, and found themselves, unless accompanied by infantry, often checked by small parties of franctireurs, and such like.

The severity of the measures, too, taken by the Germans to prevent and to punish the enterprises of partisans testifies to the annoyance caused by them.

There was but little in the late Russo-Turkish War of the nature of partisan warfare, except Gourko's brilliant dash across the Balkans in June, 1877, an operation which deserves to be carefully studied.

The British Army has had but few opportunities for carrying on partisan warfare in Europe. When acting on the Continent its numbers have been so small that troops could seldom be spared for any such enterprises. I have already alluded to Hill's brilliant exploits in 1811 and 1812, and can think of no other performance of our Army in Europe of a similar nature; but our military history out of Europe furnishes us with plenty of examples of partisan warfare, in New Zealand, South Africa, and in the larger field of India. Many a good partisan leader has been formed in the desultory warfare against the hill tribes on the Scinde and Punjab frontiers, and happily several of these still remain to help us by their counsel, or to take an active part when occasion requires. The history of those little wars should be studied carefully by all British soldiers. Sir Charles Napier's expedition to Emaum Ghur, in 1843, is a fine example of partisan warfare.[1] The same great leader's short campaign in 1845 against the robber hill tribes north of Scinde is a *chef d'œuvre*.[2]

The Indian Mutiny campaigns of 1857–58 are rich in examples of partisan warfare. Among the most notable is the use of mounted infantry by Sir Henry Havelock in the pursuit and dispersion of Ammar Singh's bands, the details of which are thus summed up in Malleson's "History of the Mutiny," vol. ii, p. 291:—"Thus sixty men, organized on a novel plan, and aided by a

[1] See the "Life of Sir Charles Napier," by Sir William Napier, 13th Epoch, 4th Period.

[2] See the same "Life of Sir Charles Napier," 15th Epoch, 3rd Period.

handful of cavalry, had effected, with almost nominal loss, in five days what 3,000 regular troops had for six months failed to accomplish, namely, the complete expulsion of 4,500 rebels from the province, and the infliction upon them of a punishment the impression of which has not to this day been effaced."

Another striking case is that of the Camel corps organized by Major John Ross, of the Rifle Brigade (now Major-General Sir John Ross, K.C.B.), which performed much arduous and useful services between April, 1858, and June, 1859.[1]

Again, in Book XVI, chapter 1, of Malleson's history we find the description of the operations resulting in the capture of Tantia Topi, which are full of interest as examples of partisan warfare. It is satisfactory to notice that no regular troops have shown more aptitude for this work, which depends so much upon individual exertions, than our own when properly organized and led. Our sailors too have been pre-eminent in this way, witness the numberless "cutting out" affairs which are genuine instances of "partisan warfare."

Partisan Warfare will be at least as necessary in the Future as it has been in the Past.

Some critics have argued that under present circumstances partisan warfare is an obsolete practice. They say, moreover, that leading, as it does, the civil population to join in hostilities, it produces reprisals on the part of the invader, and thus renders war more cruel and more destructive without producing any important result. The cavalry divisions, say these critics, do our reconnoitring work, and after all it is only the decisive strokes which tell. Why, then, carry on partisan warfare? But these gentlemen forget that the action of these very cavalry divisions often partakes of the character of partisan warfare. The latter has its peculiar characteristics. For instance, the measures for security taken by a body detached for reconnoitring purposes, and virtually engaged in partisan warfare, are quite different from those taken by the same body when in close connection with the rest of the army. In the latter case there will be a regular system of outposts, in the former only a sentry or two with a flying patrol, and in a friendly country the enemy may be still more efficiently watched by a few of the civil inhabitants. It will not do to neglect any phase of warfare. To do so will bring its own punishment. The army which does not keep up the traditions of partisan warfare would certainly be at a disadvantage if opposed to one trained and practised in it. It would not do to assume, because the latest wars have furnished fewer examples of partisan warfare than some earlier wars have done, that therefore the practice is obsolete. We must consider what opportunities the operations of armies carried on as at present afford for the action of partisans, and we cannot fail to be convinced, I think, that, if properly conducted, partisan warfare is likely to be more largely practised, and to produce greater results than ever, in the next great European conflict.

The Franco-German War is the last great precedent upon which to form our opinion, and it is sufficient to read from page 1328 to 1378 in the nineteenth part of the German official account to be persuaded both of the magnitude of the task which devolves upon the commander of an invading army under the present conditions of warfare in keeping his communications open, and of the grand opportunities which offer themselves in consequence, for the action of partisans on the side of the defence.

As the German Army made good its progress into France, the occupied territory was formed into "general governments" (those of Alsace, Lorraine, and Rheims), to each of which a body of troops, taken from the Landwehr and

[1] See Sir William Cope's "History of the Rifle Brigade," chapter xiii.

reserves, was allotted for the purpose of maintaining order generally within the Government and of assisting the étappen troops in guarding the lines of communication.

Each of the armies into which the German host was divided had its contingent of the latter, whose special duty it was to guard the communications of that army, particularly the railways, to forward supplies and reinforcements to the front and sick and wounded to the rear.

At the beginning of November, when the organization was complete, the general government troops amounted to 60 battalions, 19 squadrons, 7½ batteries; and the étappen troops to 25 battalions, 14 squadrons, 2 batteries. The total number of troops permanently employed upon the lines of communications thus amounted to 85 battalions, 33 squadrons, 9½ batteries. But during the latter part of the war this large force was not sufficient for the purpose, and considerable detachments were furnished from the field armies to reinforce them. For instance, at one time the whole of the VIIth Army Corps was placed to cover the left flank of the long line of communication of Prince Frederick Charles's army.

In despite of the magnitude of the force thus employed by the invaders to guard their communications, and notwithstanding the want of ability displayed on the whole by the French in this sort of warfare, the latter succeeded several times in doing serious damage and in causing great inconvenience to the enemy, as we have already remarked, and as we shall have occasion to notice somewhat more in detail further on. I think, then, that the events of the last great war with which we have to deal in this enquiry furnish a powerful argument in favour of the employment of partisans in future warfare, both by the invader and by the invaded, particularly as the sensitiveness of armies for their communications, particularly by rail and telegraph, is not likely to be diminished. We have already seen how much the great leaders of former days depended upon partisans, and we may observe that most of the military writers of the present day speak strongly in their favour. Not to mention Boguslawski and Devaureix, from whom I have borrowed much and shall borrow much more before I conclude this paper, I may cite General Lewal, who remarks in his "Études de Guerre," at p. 310:—"Reconnoitring cavalry must be opposed by small bodies of very mobile infantry. This is all the more necessary because the tendency of the present day becomes more and more strong towards the employment of independent cavalry. To new tactics new tactics must be opposed. Now the only way of stopping the reconnaissance of a strong force of cavalry unsupported by infantry is to meet it with little parties of infantry too mobile to be caught. All accidents of ground, all obstacles present difficulties to the action of cavalry and advantages to free corps of infantry. Partisans, properly handled, may have a great part to play."

Rüstow also advocates the employment of "little independent bodies."

Perhaps mounted infantry may prove the most useful description of force for partisan warfare except in very mountainous regions, a fact which appears to have been recognized to some extent in the preparations for our last South African wars.

It is to be regretted that our own great living military writer should have omitted the subject of partisan warfare when treating of the "Operations of War," for though his seventh chapter deals with some of the points included under that head, he leaves the general question untouched. It is to be hoped that he will add a chapter on this subject when the next edition of his valuable work appears.

Particular Opportunities for the Action of Partisans in European Warfare.

We must suppose that, as will generally be the case, the two belligerent Powers are conterminous. All the great European armies are now so far

organized after the same fashion that their peace establishments are comparatively small and have to be completed by reserves before they can take the field. It is to be presumed that when war is impending between two neighbouring Powers, each will place upon its frontier a strong force of light cavalry or of mounted infantry, or of both, with a proportion of light batteries. As soon as war is declared, the first object of these troops on each side will be to cover the mobilization and concentration of their friends, and to disturb the same operations on the part of their enemies. The aim of each side will be to act offensively and rapidly. The result will be an interchange of vigorous blows, and it will depend, *cæteris paribus*, upon the proficiency of the troops and of their leaders in partisan warfare which side gains an advantage at the outset, which may considerably affect the general result.

Thus partisan warfare will probably be the prelude to the great operations.

The next work for the partisans on each side will be to act upon the enemy's communications. We have already remarked upon the increased vulnerability in this respect of modern armies, which is due to more than one cause. First of all, to their great increase in size since the introduction of general liability for service. This increase, however, affords some compensation in that a larger force is disposable than heretofore to guard the lines of communication. Secondly, to the enormous amount of military stores which must now accompany an army, as compared with what was required before modern improvements in firearms and other scientific appliances were introduced. The vast size of modern armies again makes it impossible for them, even if it were expedient, to live for any length of time upon the district in which they may be carrying on operations. Magazines and depôts must be formed, and supplies of provisions, as well as of ammunition and other stores, must be brought from a distance. Still, the resources of the country will be utilized as far as possible, and some system of requisition will probably be put in force. An invading army will attempt to forage in advance of its outposts, and the troops thus employed will doubtless be opposed. This will give rise to many skirmishes, and the operation of foraging will become an act of partisan warfare. Whilst an army is but a short distance from its base the risk to its communications is of course comparatively slight; but as that distance increases so does the risk to the invader, and in like manner the opportunities for successful attack on the part of the defender's partisans, who will attempt to surprise small posts, to cut off convoys, to tear up railways, blow up bridges, and destroy telegraphs. Partisans must be met by partisans, and an invader will probably find that the best way of securing his communications is only to garrison a few important points, to patrol the railway lines, and to organize a sufficient number of small flying columns, which will shift their stations frequently, keep as much concealed as possible, and attempt to surprise and cut up any parties of the enemy of whose approach they may become aware; in short, fight the enemy with his own weapons. It may be remarked in passing that the very scientific appliances, which confer such enormous benefits upon armies of the present day, rendering indeed operations possible which without them would be impossible,—these very appliances increase the sensitiveness of a modern army for its communications by simplifying attack upon them, for how would it exist at a distance from its base without the connecting railway, and how would its commander receive information and communicate his orders over so extensive a sphere of operations without the telegraph?

One bridge destroyed or one tunnel blown up may paralyse a line of railway for weeks, whilst telegraphic communication may be constantly and easily broken.

Another great field for the action of partisan corps, or rather of corps engaged in partisan warfare, will be in the duties of reconnaissance, which will be carried on chiefly by mounted troops, trained to fight on foot and armed so as to be a match for infantry. It is not to be supposed that when

next a great European war takes place, one side will have over the other the advantage that the Germans had over the French at the beginning of the Campaign of 1870, with respect to the independent action of cavalry. The antagonists will probably be much more evenly matched, so that the encounters which I have supposed to take place as a prelude to the great operations may be continued in the country intervening between the two armies until one or the other side obtains a decided superiority.

I have not as yet touched upon the part which the civil population may take in partisan warfare, though this is a very important point.

With regard to the objections made, from motives of humanity, by some against civilians being allowed to take part in war, I would remark that I agree with them so far that I would not allow any man to act as a soldier at one moment and as a civilian the next. If he kills one of the enemy whilst acting in the former capacity and then seeks to escape from the possible consequences by resuming the garb of the civilian, I look upon him as a murderer and deserving of execution. He must do one of two things; either remain peaceably at home or join some armed band under proper military control and wearing some distinguishing dress. I think it is the duty of every able-bodied inhabitant of an invaded country to do the latter if called upon.

The masters of mighty legions have shown a disposition of late years to confine the operations of war to the action of regular troops, and to make it contrary to international law for civilians to take arms, and it is not unnatural that they should do so, their military resources being so great that they can perhaps afford to dispense with assistance from outside the profession; but in the case of countries with a less powerful military organization this cannot hold good, and civilians must, *under proper control*, be recognized as belligerents. We know from previous history how powerful has been the resistance made by the civil population of an invaded country, even unassisted by regular troops, much more so has it been and will it be when supplementary to them.

The Principal Phases of Partisan Warfare.

We must consider partisan warfare with reference—

1. To the nature of the country;
2. To the military and political situations;
3. To the means for carrying it on.

With regard to the first point, mountainous countries are the best adapted to it; for instance, not to go beyond Europe, Spain, Tyrol, Switzerland, Bosnia, Montenegro, Calabria. Then again, densely wooded countries and those where marshes and watercourses abound, such as Poland, Eastern Prussia, Posen, La Vendée, or a narrow peninsula held by a population superior on the sea to its invaders, such as Jutland in 1848 and 1864.

Artificial points of appui are useful to those who carry on partisan warfare, such as strong entrenched positions or fortresses held by regular troops. These serve as gathering points and refuges for the partisan bands, and are particularly needed in countries where natural shelter is deficient, such as the greater part of France, Germany, and Italy.

Of course such positions only continue to be useful as long as they are not invested by the enemy.

With regard to the second point, partisan warfare is either carried on in your own country, in one friendly to you, or in an enemy's country.

In the two former cases you will almost always have the assistance of the civil population, which is most important. This assistance may only consist in watching the enemy, giving information as to his movements, deceiving him as to your own, acting as guides, and, in short, performing any other peaceful service, or, in addition to all this, it may consist in taking arms against the invader. "War to the knife," as carried on in Spain, will be

uncommon in civilized countries and not to be encouraged, but an invading army must be prepared for it.

When carrying on war in an enemy's country the conditions will, of course, be reversed, and the invader will have to make a very much larger deduction from the force available for active operations, for the purpose of guarding his communications if partisan warfare is carried on actively by the defenders, than he will have to do if only their regular forces are opposed to him.

With regard to the means available for carrying on partisan warfare.

In former days, and indeed until very lately, every infantry battalion of the principal European armies, including our own, had its *light company*, composed of Officers and men who were supposed to be selected for intelligence, smartness, and activity. It was often the custom to unite the light companies of a division into a provisional battalion under a selected commander, and to employ it for any service requiring special dash, and also to cover the movements of the division and to reconnoitre. In all armies there were also battalions of picked men, called in our Service "Riflemen," who were armed in a superior manner to the rest of the infantry and specially drilled as skirmishers and sharpshooters. There were again "light infantry" battalions, who differed only from the rest of the infantry in being better trained as skirmishers. In those days the corps just mentioned would be those most fitted for partisan warfare. Since, however, the whole of the infantry has been armed in like manner, and since all foot soldiers have received, or been supposed to receive, equal instruction in fighting in extended order, some of the distinctions referred to have been abolished and the rest have almost ceased to have any practical meaning, for "light companies" no longer exist, and though "rifle battalions" and their equivalents continue to be maintained in European armies, their superiority, if any, over the remainder of the infantry consists in the prestige resulting from their previous history.

(The German Schützen and Jäger battalions are, it is true, recruited from amongst foresters and gamekeepers, and, therefore, have perhaps some advantage in point of material over the line regiments.)

Corps d'élite having thus almost ceased to exist, and yet all men not being equally fitted for the work of light troops, it becomes necessary to select them in another way. Thus, at the Siege of Sevastopol, both English and French, and at the Siege of Metz, the latter formed companies of "sharpshooters," or "free companies," consisting of volunteers from the different infantry regiments. At the former siege these men were employed in the advanced trenches, or in rifle-pits, in front of them, chiefly to fire upon the enemy's gunners. The Russians also formed companies of volunteers who led the way in the night sorties. At Metz the "free companies" rendered still greater services, to which I have already alluded.

I believe that taking into consideration the uniformity of training which is supposed to and ought to exist, and the uniformity of armament which does exist, the best way of providing partisan corps for future warfare will be to select whole companies, or, if necessary, whole battalions or even brigades, for the purpose, taking into consideration, above all, the qualifications of the commanding Officers. If they are the right men all will be well. Any bad material in the lower ranks will be weeded out before it does much mischief. But to find companies, battalions, and brigades fit for the independent work of partisan warfare, the whole Army must be trained to it in peace time. The following passage from Colonel v. Boguslawski's book is worthy of note :—

"The tendency which is growing up in armies only to train troops for decisive action, to avoid dispersion, to check the independent action of skirmishers, and to restrain them by a rigid fire-discipline; all this tends, even if involuntarily, to do away gradually with partisan warfare. But if

we go too far in this direction, that is to say, if we keep down too much the independent spirit, which is a characteristic of the true skirmisher, we shall certainly find that some day partisan warfare will be all the more dangerous to us.

"There are doubtless situations in the warfare of the present day in which the action of partisans is out of place, but there are also situations to which it is peculiarly applicable.

"The practice of training us only for the great operations of war, for actual battle, has often misled us into putting aside as of infrequent occurrence, and, therefore, as not worth practising, the combats of isolated battalions or companies. Not to mention that battle is, after all, a mere compendium of separate though connected engagements, such conflicts are of frequent occurrence, as shown by the events of 1870–71, and it behoves us to be as superior to the enemy in fighting of this description as in actual battle."

In treating of the *means available for partisan warfare*, I have hitherto only spoken of infantry, and in some cases this will be the only description of force able to act; for instance, in the very countries where, as a rule, partisan warfare has been carried on with the greatest effect, namely, in densely wooded or very mountainous regions. Elsewhere, however, and this will be the rule rather than the exception, cavalry, light artillery, and mounted infantry will come into play. For the latter description of force, above all, there will be a great opening in future warfare, and happy the land which will be found provided with it when the day of trial comes. As for the mounted troops, they will require quite as much special training for the independent work of partisans as will infantry; moreover, their equipment and armament will probably have to be remodelled before they can be made efficient in this way.

Our Indian Irregular Cavalry Officers might give us some useful hints and should be consulted. But besides the field army, many nations have other sources to draw from for partisan corps for home defence before coming to the civil population. The Austrian-Tyrolese have their rifle companies, the Italians their Alpine companies, the British their volunteers. The services rendered in former days by the Tyrolese in defence of their country are well known, and there is no reason to suppose that they would on a future occasion be less valuable; the Alpine companies are only newly raised and have not as yet been tried in war. As for the British volunteer, he would not have the advantage derived from the nature of the country enjoyed by the Tyrolese and the Italian, but it is to be hoped that if unfortunately the occasion should arise for his being called upon to take arms in earnest, he would make an efficient partisan, for probably some of the most important work that he would have to perform in case of invasion would be that of harassing the enemy's communications, a work for which his skill as a marksman, his local knowledge, and his general intelligence should peculiarly fit him.

But to qualify them for this special work, volunteers as well as regulars, especially the Officers, must receive special training in peace time.

With regard to the employment of the civil population in partisan warfare, I would say with the author of the article in the "Journal des Sciences Militaires":—

"We most decidedly condemn any independent levy, whatever its nature may be, unless its members have previously been subject to discipline and to purely military control, and unless it be officially under the Commander-in-Chief of the Army."

Still, if England were invaded, I should be sorry if all legitimate means were not used for its defence, and, therefore, I hope that, in caseof imminent danger of invasion, partisan corps would be formed, trained and led by some of the many retired Officers still fit for active service. I doubt not that such corps would be of great use.

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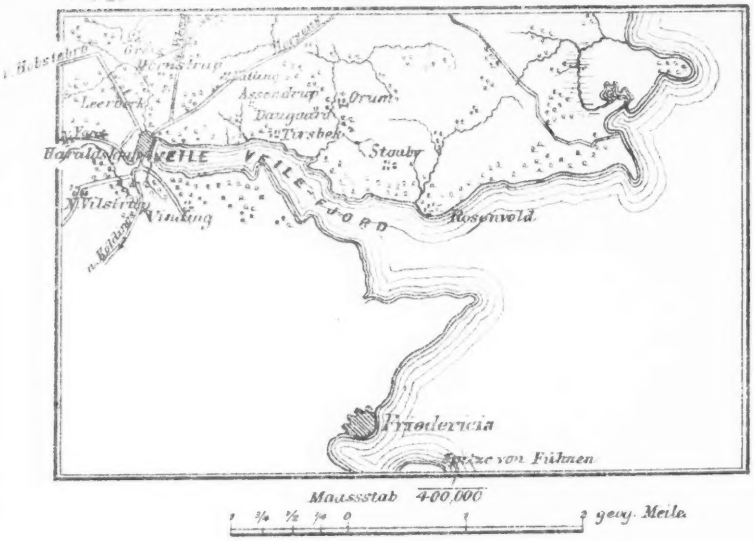

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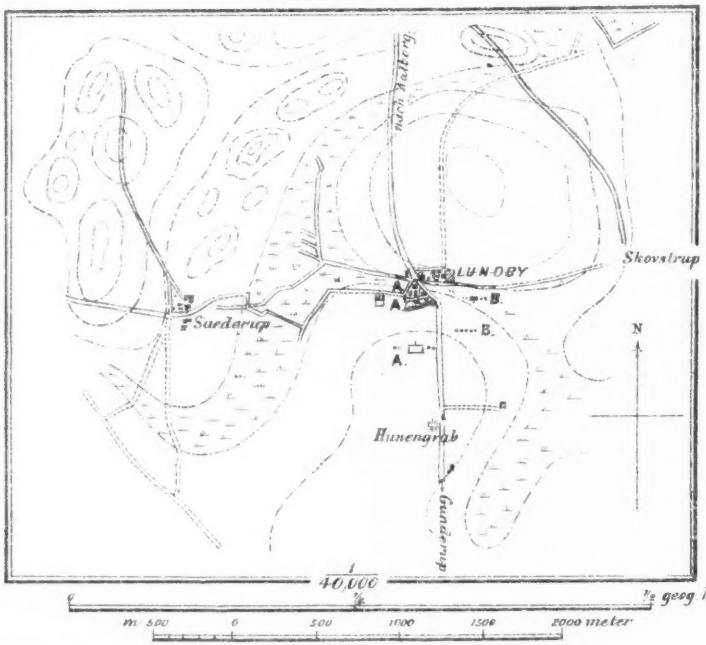

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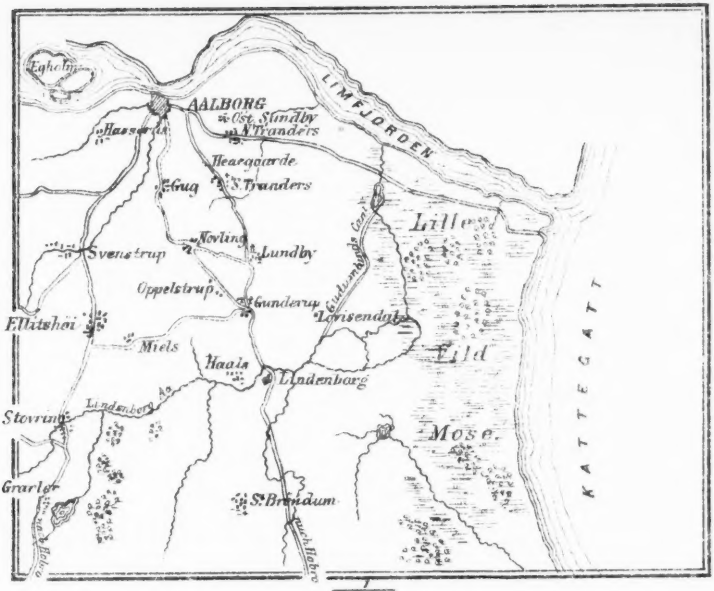

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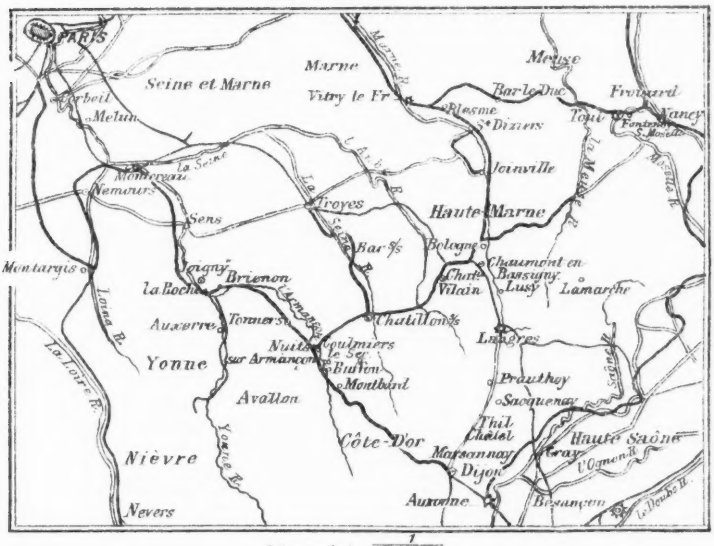

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"The first condition of success in partisan warfare on the part of an invader is distrust of the civil population" (says Boguslawski), and he goes on to remark how often the soldier in an enemy's country forgets all caution and gossips over his glass of wine with the natives, forgetting that he is in company with his enemies. It will not do for the partisan to act thus, for success in partisan warfare depends greatly upon secrecy.

When in his own country the partisan may to a great extent trust to the natives to watch for him, but when in an enemy's country he must watch the people as well as the hostile troops. At the same time it would be both wrong and impolitic to behave with brutality or want of consideration towards the natives; such conduct would only exasperate them and drive them to take arms. As long as they remain quiet the invader should endeavour to keep on good terms with them, and if money be plentiful supplies should be paid for on the spot. Information, and above all, newspapers should be bought. The effect of good discipline and of ready money in favour of an invader is wonderful. When Wellington's army entered the south of France in 1814, it was better supplied with provisions than was Soult's army, because the troops of the former behaved well and everything was paid for on the spot, whilst the French soldiers plundered and everything required for the army was taken by force. The partisan leader should bear this in mind. Offensive action is a necessary element of partisan warfare, whether the main army, to which the partisans belong, is acting on the offensive or on the defensive.

A partisan corps must always be on the move, and being comparatively unhampered by baggage, it will be prepared at any moment to change its line of march or its plan of operations, and to appear where and when least expected.

Examples of Partisan Warfare in Europe of the most Recent Date, with Critical Remarks.

The War of 1864 *in Denmark.*[1]

The war of 1864 furnishes us with several good examples of partisan warfare, both on the part of the Danes and on that of the Prussians. The most notable are the surprise of Assendrup on March 28th, and the combats of Lundby and Sönder-Tranders on June 3rd. The nature of the country favoured the defenders, but they could not make proper use of this advantage owing to their want of numbers, and also to the failure of energy consequent upon their sense of inferiority to their assailants, abandoned as they were by Europe in face of the powerful coalition against them. A *levée en masse* of the population was wisely not undertaken, for though the nature of the country was, as before said, favourable in many ways to partisan enterprises, yet it contained no mountains, no great forests, no fortresses conveniently situated, no safe refuges, in short, for bands thus employed. The people were, however, all disposed to assist their defenders in other ways, for instance, by watching the invaders and by giving information about their strength and movements, doing in this manner good service to the cause. The resources of the country in horses and carts were large, and much used by the defenders for the rapid conveyance of infantry. Colonel v. Boguslawski gives an interesting account of the surprise of Assendrup, which was occupied by a Prussian detachment consisting of one Officer and seventy hussars. The general situation towards the end of March was as follows:—

General v. Tümpling remained in Holstein with six battalions as a general reserve. The combined Prussian corps lay before Düppel, together with nine

[1] See Map 17 in Keith Johnston's "Royal Atlas," and the plans in Colonel v. Boguslawski's book, which latter are reproduced.

battalions of the combined division of the Guard. The Austrian army corps lay in cantonments before Friedericia and at Kolding, investing the former fortress. A Prussian detachment, composed of the Hussars of the Guard, the 8th Hussars, the 6th Cuirassiers, together with three battalions of Fusiliers of the Guard, and two batteries under General Count Münster, lay in and about Veile.

The Danes held with their main body the position of Düppel and the Island of Alsen, occupying also Friedericia with a sufficient garrison, and keeping a division composed of six battalions of infantry, eighteen squadrons, and two batteries in the central and northern parts of Jütland.

The eastern coast of the peninsula rises generally to the height of several hundred feet above the sea, and is in many places well wooded, so that the unobserved landing of small detachments is much facilitated, particularly as the whole coast line is intersected by deep bays (*fjords*) and studded with numerous islands. The west coast is much flatter and sandy. The interior is poor and hilly, with a good deal of heath. Throughout Jütland you find numerous watercourses with marshy banks, and in some parts chains of lakes and marshes.

The detachment at Assendrup formed one of rather an extended chain of posts, furnished by the Hussars of the Guard, to cover Veile on the north. The Danes, who were of course well acquainted with the localities and with the dispositions of their enemies, determined to attempt a surprise. For this purpose a detachment of 200 infantry was conveyed by sea to Rosenvold, about 8 miles from Assendrup, where they landed on the evening of the 26th March. Early on the 28th, a party of fifty men being left to guard the landing place, the remaining 150 concealed themselves in one of the neighbouring villages till the afternoon, when they were conveyed in carts to Dangaard, 4½ miles east of Assendrup. Here they remained in some farm buildings till midnight, when they marched off guided by peasants on Assendrup. They met no Prussian patrol, for the Officer in command was only in the habit of sending out patrols by day to Orum, about 2 miles distant, and along the Veile-Fjord, whilst by night the precautions taken were a guard of eight men in the village, barricades at the entrances, and small picquets about 100 yards outside. Arrived at the entrance of the village the Danes made a rush, overpowered the guard, surrounded some of the buildings. and captured twenty-four men with twenty-five horses. The whole skirmish lasted six minutes, and then the Danes marched back to Rosenvold with their prisoners and re-embarked. The Prussian detachment owed this disaster simply to want of proper measures of precaution by night, and to the day patrols not having performed their duty with sufficient care. The Danes did their work well, making good use of the peasants as scouts, keeping themselves well concealed, and making their attack with vigour and energy. They retired, too, at the right time without running the risk of collision with the stronger forces which occupied the villages in rear of the hussar detachment. The result of this little affair was not only the capture of men and horses, but great inconvenience and disturbance to the enemy, who thought it necessary to strengthen his outposts and to make a greater concentration of his forces.

The Combats of Lundby and Sönder-Tranders.

Space will only admit of a very short abridgment of the account of these affairs given in "Der kleine Krieg;" but it is well worth studying *in extenso*, as an instance of what was intended as a combined movement on the part of three mixed detachments of cavalry and infantry for the purpose of making a reconnaissance, but which resulted, as it turned out, in the effective action of only two of these detachments.

The general situation at the beginning of July was as follows:—A Prussian army corps, provided with a large pontoon train, was intended, after the

armistice, to cross the Limfjord at Aalborg, and to occupy the northernmost part of Jutland, called the Vendissel, whilst an Austrian detachment of all arms was to cross from Skive to the Island of Mors. The advanced guard of the Prussian corps was at Hobro and on the Mariager-Fjord. The remaining troops échelonedfrom Randers to Hobro.

All that was known of the Danish troops in Vendissel was that some detachments from thence had recrossed the Limfjord and taken post to the south of it. At the same time, it was judged from the great movement of vessels from north to south that Danish troops were being conveyed from Vendissel to Fühnen.

The movement of the allies across the Limfjord had to be delayed till the 8th July, as the pontoons were not complete. Meanwhile it was thought desirable to obtain certain information respecting the enemy's troops which had been pushed over the fjord.

With this object in view three detachments were pushed forward :—

Beginning from the right.

1. Two companies of infantry with one squadron of hussars, under Major v. Krug, on the Hobro-Lindenborg road.

2. Two companies of infantry with forty cuirassiers, under Captain v. Dyhern, on the Hobro-Aalborg road.

3. Two companies of infantry with one squadron of cuirassiers on the Hobro-Logstör road.

These parties were all ordered to reach the fjord on the 3rd July, and to return on the 4th and 5th. The infantry companies were made up of picked men, and each detachment was accompanied by a certain number of carts.

The country to be traversed was hilly, thinly peopled, poorly cultivated, and with swampy watercourses in the bottoms.

No. 3 detachment may be left out of count, as it took no part in what follows, though it fulfilled its object.

The centre detachment, whose line of march was not more than from nine to thirteen miles from that of No. 1 detachment, with which it was to maintain communication by means of cavalry patrols, marched from Hobro on the 1st July at 8 A.M., spent the night at Gravlev, and in its forward march next day encountered, at 11 A.M., a small Danish detachment of dragoons with a few foot soldiers in carts, who had also been pushed forward to reconnoitre. A few shots were exchanged and the Danes retired.

The Prussian patrols now reported the presence of considerable Danish columns in front and on the flanks. These imaginary columns were really only stacks of peat, but the Prussian commander trusted to the report of his patrols without proper investigation, and, not having any news of the other detachments, withdrew to his original starting point, sending, however, notice of this withdrawal to Major v. Krug. The latter Officer performed the task allotted to him in a very different manner. He spent the night of the 1st July at Store Bröndum, and on the 2nd crossed the Lindenborg stream, leaving two-thirds of a company and six hussars to protect the passage, and advancing to Louisendaal. He remained there with his detachment in readiness to turn out at a moment's notice till 8 P.M., sending scouts towards Lundby and Lindenborg. He learnt from the natives that two Danish companies and one squadron were at Sönder-Tranders. He sent information to Captain v. Dyhern. At 8 P.M. he again put his men in movement and marched on to Gunderup on the Aalborg road, where he stowed this party away in a large churchyard. He here received intelligence, at about 10 P.M., from Captain v. Dyhern of his retreat to Gravlev, and of the cause which had occasioned it, notwithstanding which he pushed on next morning at 2.30 A.M., sending his baggage back to Lindenborg, and reaching Lundby at 3.30 A.M. This place is, from its position, an important point. The Major here left the greater part of his infantry, namely, 5 Officers and 124 men, under Captain v. Schlutterbach,

advancing himself with the remainder of his hussars, ¾ squadron, and 20 foot soldiers in carts to Sönder-Tranders. The Danes had then in reality in Vendissel itself only 1 infantry regiment, 1 dragoon regiment, ½ battery, and 1 company of engineers, and only a very small force south of the Limfjord, but hearing, on the 2nd July, of the advance of the Prussian centre detachment, they determined to try and cut it off. For this purpose a party of 3 Officers and 184 infantry with 16 dragoons were sent across the fjord. They soon heard of the retreat of Captain v. Dyhern's detachment, but advanced as far as Ellitshoi. Hearing now of Major v. Krug's movements, Colonel Beck, who commanded the Danes, determined to fall upon his rear and try to cut off his detachment. He, therefore, marched, under the guidance of some peasants, by Miels on Gundrup, which place he reached at 3.30 A.M. on the 3rd, to find that the enemy had marched away northwards. He followed on their tracks and reached the neighbourhood of Lundby at 4.30 A.M., after a night march of about eighteen English miles. The Prussian detachment was on the alert, and on the first alarm took up as good a position as it could find facing the enemy, that is to say, towards its own line of retreat.

As soon as Beck observed the Prussians he ordered a bayonet attack upon them without attempting to cover the movement or to take any advantage of the ravines which ran down upon each flank of the enemy's position.

Captain v. Schlutterbach had formed his little detachment in the houses and behind the walls and hedges on the south side of the village across the road, keeping in hand a reserve of forty-eight men behind a small house about seventy paces in rear of the fighting-line. The Danes had to pass over about 700 paces of open ground, which they attempted to do in column of sections at the double with a few skirmishers in front. Captain v. Schlutterbach let them come on to within 200 paces before opening fire. His men then fired two volleys from the knee or lying down under cover, the second when the assailants were within 125 paces, afterwards taking up a hot "schnell feuer." The Danish column advanced gallantly so far, but now broke up, only some small parties pushing on. These, however, came also very shortly to a standstill. The men threw themselves down in an oat-field in front of a hedge lined by the enemy and opened fire, but in this, of course, the advantage was all on the side of the Prussians. A small party of Danes now tried, much too late, to gain one of the above-mentioned ravines, but was annihilated by a Prussian section detached to meet them. After about a quarter of an hour the Danish company, having lost its Officers, took to flight, and gained the shelter of a neighbouring hill, from which Colonel Beck was witnessing the action. Their loss was 3 Officers and 98 men killed and wounded, besides 12 men made prisoners. The Prussians had 3 men wounded.

Meanwhile Major v. Krug, with his small party, came upon an Officer and 20 men reconnoitring. This little detachment, which was first observed a little to the north of Sönder-Tranders, retired to a farm strongly situated on high ground. The Prussian foot soldiers, leaving their carts, skirmished up to the the enemy and drove them from hill to hill, whilst the dragoons worked round their flank, upon which they had to surrender. Major v. Krug now received notice of the appearance of the enemy at Lundby, to which place he hastened only to find the combat over. He then marched away with his prisoners, and returned to his original post, picking up his other detachment on the way. There cannot be a greater contrast than between the conduct of the commanders of the two Prussian detachments. The one showed inexperience, indecision, timidity; the other all the qualities of a good partisan leader. His wise boldness in not being deterred from carrying out his mission by the alarming reports which reached him from the left merits particular notice. Captain v. Schlutterbach deserves credit for the presence of mind and ability displayed at Lundby. He ought, however, to have had a vedette on the hill south of the village, from behind which Colonel Beck's party

approached unobserved, till the Colonel and staff showed themselves on the top.

The Colonel was too rash in his attack. He was not warranted in acting as he did, even by the tactical teaching of the period in which he had received his training. Against well-trained steady troops, armed with the needle-gun, such an attack could not but fail. This contest of Lundby is interesting as one of the earliest examples of the power of the breech-loading rifle.

The whole story of the reconnaissance is an excellent illustration of partisan warfare, furnishing us, as it does, with clear examples of what to do and what to avoid.

Interruption to the Line of Communication of the 2nd Army from August, 1870, to the end of January, 1871, and the influence of the Fortress of Langres on the situation.[1]

The history published by the Prussian General Staff of the war of 1870-71 furnishes in the chapter on "Occurrences in rear of the German Army" (Part 19) an interesting and instructive account of the manner in which the communications of that army were interfered with by partisans, and gives us plenty of food for reflection on partisan warfare generally. After reading it we cannot, I think, fail to be convinced of the fact that partisan enterprises directed upon an enemy's communications, particularly when that enemy is an invader, are destined to play a great part in future warfare.

When the 2nd Army advanced upon Orleans after the fall of Metz in November, 1870, it had to make use of the various roads leading from Nancy to the line Troyes-Châtillon-sur-Seine (about 100 miles). Detachments, whose strength varied from that of a company to that of a "zug" (one-third of a company), or even less, occupied all important points along the line of march. As the army progressed westward, its line of communication became naturally longer and longer, and the number of these posts had to be increased. Directly on the left flank of the line of advance was the fortress of Langres, occupied by 12,000 men, of whom one-third were regulars, and observed by a German detachment of 6 battalions, 2 squadrons, and 2 batteries. Further to the south (about 45 miles) lies Dijon, then occupied by the XIVth German Army Corps. Garibaldi, then at Autun (about 45 miles south-west of Dijon), had pushed forward a party of 660 men, including a few hussars under his son Ricciotti, to Montbard (about 20 miles from Chatillon-sur-Seine) for the purpose of harassing the enemy. Montbard was reached on the 19th of November, Châtillon being then occupied by 3 Landwehr companies and a squadron of reserve hussars. On the 16th Ricciotti moved on unobserved to Coulmiers-le-Sec, about half-way to Châtillon, advancing again next morning on the latter place with only 400 men in two columns. The German detachment had been in the habit of sending out patrols and picquets only at night, and these parties had retired when the enemy approached, only a quarter guard being stationed at the entrance of the town. Thus the Germans were completely surprised, a great many of them being caught in their quarters. The mairie and préfecture were held by them for some time, but the commanding Officer, being alarmed by a false report of more enemies having appeared in his rear, evacuated those buildings and withdrew to the other side of the river, which divides the town in two.

Ricciotti, after this success, withdrew to Coulmiers, and next day to Montbard, whilst the German detachment retired at the same time to Château Vilain (about 20 miles), having heard that the attack was upon the point

[1] See any good map of France; above all, that of the German communications in Part 19 of the General Staff history, also sketch in "Der kleine Krieg," which is reproduced.

of being renewed in greater force. It only reoccupied Châtillon on the 21st when reinforced. This little affair, in which a party of 400 men surprised and defeated one of about 500, inflicting upon them a loss of 8 Officers and 186 men,[1] is a good instance of partisan warfare, principally as showing how bad arrangements lead to disaster. Ricciotti was probably well served with spies, though, as has been before remarked, Garibaldi's people did not, as a rule, receive as much assistance from the French as they might have expected. He deserves credit for the vigour, energy, and secrecy with which he conducted the operation. He, however, owes his success chiefly to the supineness of the German commander, who had no excuse for not reconnoitring properly, being well supplied with cavalry. He appears also to have had no infantry outposts.

Ricciotti's affair led to a good many other small attempts of the same nature, some of which were successful, whilst all were troublesome.

By the beginning of December the railways in those parts were pretty well re-established, and the 2nd Army was able to use the line branching off from the great Paris-Strasburg line at Blesme to Chaumont, and later on to Châtillon and Troyes. The VIIth Army Corps was left at Nuits as the 2nd Army pushed on towards Orleans, and was directed on Chaumont and Châtillon at the beginning of December, to cover the communications of that army and to keep up its connection with the XIVth Army Corps at Dijon. Meanwhile the General commanding at Langres had begun to show some activity, sending out parties of picked men to molest the Germans. They were not able to do much injury to the railways, and the presence of the VIIth Army Corps to a great extent put an end to these enterprises and to those of the many franctireur bands. At the commencement of January, however, the situation in those parts was changed, as the VIIth Army Corps joined the IInd Army Corps (detached from the 3rd Army) in its movement southward to encounter Bourbaki, its place being very incompletely filled by five Landwehr battalions detached from the étappen troops of the 3rd Army. The line between Blesme and Châtillon (about 100 miles) was then guarded by 6½ battalions, 1 squadron, and 1 battery. A brigade of the IInd Army Corps, under Kettler, at the same time watched the line Châtillon-Nuits and the communications of the Southern Army, but it had shortly afterwards to move on Dijon, where it succeeded in holding Garibaldi in check, being only able to leave two companies at Montbard. The railways used by the Germans became day by day more extended, hence there was a greater opening for activity on the part of partisans, and many attempts were made by them, some of which were successful, notably the one on Buffon, near Montbard, where a Garibaldian party managed to blow up the railway bridge over the Armançon on the night of the 3rd February. These attempts had the effect of interrupting the direct communication of the 2nd Army with its base, in consequence of which the roundabout route by Lagny, properly belonging to the 3rd Army, had to be used. A brigade of the VIth Army Corps from the army before Paris was ordered to move to those parts in consequence, but before this order was carried out the armistice was concluded.

Of all expeditions of this nature, however, made by the French, the surprise of the railway station at Fontenoy-sur-Moselle near Toul, which resulted in the destruction of the railway bridge at that place, was the most important. This took place on the 22nd January, and the damage was not repaired till the 4th February, the whole of the traffic for the 2nd and 3rd Armies having meanwhile to go round by Metz and Rheims to Epernay, Fontenoy being on the great main line from Strasburg to Paris. It may be imagined what a

[1] So says Boguslawski, but according to Dr. Engel's official account of the "Losses of the German Armies," the loss at Châtillon was only 8 officers and 147 men.

serious inconvenience this was, and how embarrassing it would have been had the war not come to an end as it did.

The Surprise of Prauthoi, January 28, 1871.

Towards the end of January General Kettler with his brigade was occupying the environs of Marsannoy, about 20 miles from Dijon, on the road to Langres, holding in check Garibaldi, who still remained in the former town. The garrison of Langres began to show signs of renewed activity, and Kettler, anxious for his rear, despatched three companies of infantry and a few dragoons to Prauthoi, which is about 15 miles south of Langres, for the purpose of observing the garrison of that place. On the 28th January the German detachment was parading in the village street at 6.15 A.M., for the purpose of marching back to Thil-Châtel on the Dijon road. It was suddenly attacked with great vigour by a body of troops sent out from Langres. This party, composed of regulars, gardes mobiles, and francstireurs, was divided into two columns, which had made a night march round the place with the intention of attacking the Germans on both sides, cutting them off from their line of retreat and driving them into Langres. The attack, which should have been made at 3 A.M., was doubtless delayed by some accident, and consequently the Germans were all under arms, which would otherwise not have been the case. The French forced their way through the chain of sentries on the south side of the village, drove back the guard, and occupied the south entrance. Their skirmishers established themselves in the neighbouring houses and behind the German baggage carts, which were formed up in readiness to move off. The Germans charged the foremost French with the bayonet and drove them back, whilst detachments worked upon their flanks through the gardens and houses. But reinforcements began to join the French on the south side of the village, and another strong column showed itself in the opposite direction, so that the German commander thought it advisable to break off the engagement and to retire. His direct line of retreat being blocked he made a *détour* to his left, and retired in good order, though under a heavy fire from the two French columns. He was obliged to abandon his baggage, and lost 6 Officers and 108 men (so says Boguslawski, who got his information from an eye-witness; but Engel puts the loss at 4 Officers and 93 men, and the General Staff history at 4 Officers and 77 men). Less steady and war-trained troops would doubtless have suffered more severely; bad troops would probably have been dispersed. Had the French shown more dash their success would, in all probability, have been greater, even against these well-trained soldiers. Instead of taking shelter in the houses and behind the baggage to skirmish, they should have taken advantage of the first moment of surprise to charge the enemy vigorously in the narrow street. As it was, the hesitation displayed by the assailants gave the Germans time to pull themselves together, to deploy and to take the offensive. The delay experienced by the assaulting columns in reaching their goal was not surprising, and is not an unusual feature of night attacks.

The difficulty of ensuring punctuality when combined movements are attempted in the dark is one of the objections to night attacks, which have, however, so much to recommend them, particularly in these days of breech-loading rifles. At Prauthoi, as in other cases of surprise, there was probably a want of proper measures to guard against it, or a want of proper vigilance on the part of the picquet sentries. Situated as the German detachment was so near a fortress strongly garrisoned by the enemy, the greatest caution was obviously demanded.

"*Training for Partisan Warfare.*"

Such is the title of Colonel v. Boguslawski's last chapter, from which I shall make large extracts in his own words as well as I can render them.

"Is it necessary and useful to prepare troops and their leaders for partisan warfare by training in time of peace, and if so, is it possible? Can we represent such acts of war at our peace manœuvres? Let us first consider the soldier's training individually and collectively. The distinction between light and heavy troops has about ceased to be. With regard to infantry, indeed, the jäger may still be looked upon as special corps of light troops; with regard to cavalry, however, there is less difference between the various kinds in respect of tactical training than in the weight of men and horses, and, as far as concerns the Prussian cuirassiers, in armament.

"At all events, both the linesman and the jäger, both the light and heavy dragoons must be so thoroughly trained, both for the great operations of war and for partisan warfare, that they may be all used equally well for either purpose. There will be nothing new in what is yet to be said, there will be no novel receipts for the instruction of troops. Attention will merely be drawn to certain points, the observance of which one is apt to lose sight of during peace, a state of things to which perhaps Europe may again look forward for a time. The instruction of the private soldier in partisan warfare consists in nothing more than in careful training for fighting in extended order, and for outpost and reconnoitring duties, in developing the intelligence and in strengthening the *morale*. You may, indeed, go so far as to pick out some of the sharper men who promise to become useful as patrol leaders in the cavalry, and as squad leaders in the infantry, giving them some idea of the great difference which often exists between the performance of outpost duty by small detachments sent to a considerable distance, and when carried out by large concentrated bodies of troops.

"You must give the average man something tangible to grasp. It will suffice, however, to describe briefly the action of a partisan corps, taking care, as in training men for patrol duties, to lay stress more upon quickness, suddenness, and secrecy than upon the fighting part of the business.

"Theoretical instruction of the same kind should be given to non-commissioned officers.

"Another particularly useful preparation for partisan warfare appears to be the practice of sham alarms and night attacks, a practice which has for some time back got into rather bad repute in the army, but really without fair cause. The reason for this feeling with regard to sham alarms is that there was often a certain amount of *humbug*[1] connected with them which gave them the semblance of useless child's play; yet it is extremely important that the young soldier should be accustomed, whenever the assembly sounds, to hurry to the alarm post like a flash of lightning, that he should be able to find his way about by night as well as by day, and that a body of troops should form up under such circumstances with the same regularity and good order as on midday parade in the barrack square. In former days no manœuvres came to a close without a night exercise of this kind, which was certainly calculated to give young Officers and soldiers a little picture of the troubles to be encountered on service. We were in those days less well informed about the configuration of the groups of hits upon the target, but we paid greater attention at our field exercise to the unexpected incidents of warfare, which often exercise so decided an influence upon the condition and the fighting efficiency of a body of troops.

"The night attack has its advocates and its opponents. It is doubtless difficult to regulate, but if well managed, often promises great and decisive results. Many think that in future warfare it will be practised more than ever, because the fearful effect of the firearms of the present day leads the assailant to place faith in darkness, secrecy, and surprise. Be this as it may, the night attack will always retain a peculiar importance in partisan warfare.

[1] *Sic* in original.

It will enable the assailant to take the most complete advantage of the element of surprise. At any rate, it seems desirable to accustom troops to it, and to make them observe the strictest discipline during such enterprises; but above all, the lower grades of Officers must be taught that a night combat, particularly on the offensive, demands quite a different system of tactics to that required by day; in the former fighting in close order being the rule, in the latter the exception. The above-mentioned points are the sole peculiarities of training for partisan warfare required by the private soldier, but the leader should go through a more extended course, which appears at the same time to be more easily carried out; and I am bound to say that too little of this sort of thing is done, particularly by our infantry.

"The whole way in which the reconnoitring service of our cavalry is conducted at the manœuvres constantly brings the junior Officer into situations resembling those of partisan warfare, and the necessity to which he finds himself forced of keeping his party concealed, of securing himself against surprise with the smallest expenditure of force, leads him of itself to adopt the most natural and the simplest means of gaining his object, and to emancipate himself from routine when it appears, as it sometimes does, impracticable, even dangerous. With infantry this is less the case. Although outpost duty in front of an army is only partly performed by that arm, whilst its share in that of reconnaissance is still more limited, its action in partisan warfare, particularly in a mountainous or wooded country, is, as we have already seen, pre-eminent. The infantry Officer should therefore, like his comrade in the cavalry, have a right conception of how to perform the task in partisan warfare which may possibly fall to his share, the first step towards which is to understand its nature. First of all, be it remarked, the individuality of the actor comes more into play here than in any other phase of warfare. The man of independent mind and strong will, the man of enterprise, the man who goes out of his way to seek adventure, will far more readily take in the idea of what partisan warfare should be. I do not mean by any means to assert that it is possible to form every Officer into a good partisan leader, but we must endeavour to bring all up to a certain point, for it will not always be possible to pick out men specially adapted for the purpose.

"As with respect to everything else, we must not neglect the study of good works upon the subject, and above all we must seek for good examples from military history; for, as we have already tried to demonstrate, it is much less easy to theorize on partisan warfare than on great operations, although in either case a few main principles hold good. The next mode of instruction should be working out tactical examples in the field with supposed troops. These exercises may be planned and carried out in the same manner as the so-called cavalry excursions for practice,[1] with which indeed they might be combined.

"Every Officer has one branch of military study always at hand, namely, the study of ground with reference to military operations. Perhaps it would be too much to expect him to do this when taking a pleasure trip. The only men who will do so will be those whose minds are constantly occupied with their profession, and to whom the application of a military idea to a special bit of ground has grown into a habit.

"It will be enough for ordinary mortals to study the country from a military point of view during their rides in the neighbourhood of their quarters and when marching to and from the field of exercise. If the student sets himself little tactical problems and writes out the solution at once on his tablet, he will gain the habit of forming a rapid and correct estimate of a position. The concoction and solution of such problems have often been practised in

[1] "Kavallerie-Uebungsreisen."

one form or another in our Army, but we often forget that it is too much to expect of Officers who are already hard worked in the daily routine of duty to work out such problems carefully, and moreover that there is often too great a tendency towards a pedantic adherence to form, and that frequently the man who produces the best executed plans and goes over most ground gains the highest praise, whilst all that is really required is that the characteristic features of the country and the places with which the problem is connected should be noted, and above all that the greatest accuracy and quickness should be displayed in performing the task, a point which is seldom attended to by regimental Officers. I think, too, that it would be well to deal with such problems more regimentally, that is to say, not to make such an official business of it, not to submit the results of the studies to too exalted an authority ; for there are men whose nature is such that when compelled to adhere to strict forms, and when subject to a control for which they have a rooted aversion, they lose all power of reflection and of clear expression. It is, of course, just as important in partisan warfare as in great operations that an Officer should be able to form a rapid judgment of the tactical nature of a position. There is a difference, however, between this faculty and that of being able to realize your own situation quickly, and to have a good memory for ground. It is said that the educated man is inferior in this latter point to the uneducated man, particularly to the peasant, forester, or woodcutter, these again been often less gifted in this respect than the savage ; at any rate, it is a fact that the man who occupies himself with scientific pursuits will lose to a great extent the faculty of finding his way about in a strange country, unless his studies are specially directed to the point, because his mind is occupied with things beyond the ordinary experience and the common events of life. The power of finding one's way and of keeping in mind the features of the ground, which appears to be inborn with some men, really is engendered by necessity and by professional habits, which improve the memory. By giving the latter plenty of practice, and by observing all landmarks which may be of assistance to you in finding your way, you will, at any rate to a certain extent, supply by artificial means the place of the lifelong habit which has in some cases been the consequence of necessity.

"The Officer, then, who aspires to distinguish himself in partisan warfare, must cultivate a good eye for country and a good memory for localities. He must, of course, also be able to read a map thoroughly well, but it is hardly necessary to remark that the maps which we carry about in the field, being often not sufficient for our requirements in great operations, are still less frequently calculated to meet our wants in partisan warfare.

"Another means of training employed is the solution of problems in partisan warfare with actual troops, and this leads me at once to enquire whether this practice is generally useful, and more especially for Officers and non-commissioned officers.

"It has been the fashion to contest this utility of late, and much less has been done in this way ; in many regiments, indeed, no instruction of the kind has been given to non-commissioned officers for some time back, because, 'tis said, combats of this description so rarely occur, because, moreover, the practice was generally carried out in an unnatural manner, giving a false idea of war and teaching nothing. Even supposing all this to be true, the fault would lie principally with those who planned and directed the exercises. It is, indeed, no easy matter to do this well. I almost think that the smaller the scale of the exercise the greater the difficulty in planning it. But even admitting the defects of this sort of training, I would ask, how can the tactical capacity of a young Officer, or of a non-commissioned officer, be better tested than by giving him a problem of this description to solve? The powers of reflection and of decision are equally promoted : the qualities which are necessary to a leader of men, to a General, are discovered in a

latent state and developed. Such are the arguments in favour of these exercises. It is not enough to attend only to the training of the men. That of their leaders is on the whole of higher importance. How often have young and untrained armies fought excellently well under good leaders (for instance, Napoleon's young army of 1813, under Officers and non-commissioned officers detached from the army in Spain). Now, there is no doubt that these tactical exercises may do a deal of mischief if conducted on false principles, as they often are, the chief fault being that they are frequently connected with the great operations of war in a clumsy manner. * * * *

"If a young Officer shows signs of having somewhat profited by the lessons which he has learnt at the 'Kriegsschule,' on the principles of tactics, let him, by way of practice, post an outlying picquet with real or supposed supports, give directions to an ordinary patrol, or prepare a small position for defence. Then, if he shows himself to be well up in such matters, the best way of testing and developing his faculties will be to set him some problems connected with partisan warfare. It is of the greatest importance that, in drawing up a scheme for him to work out, you should not take the first thing that comes into your head, but that you should take into consideration the peculiar characteristics of the individual and the nature of his previous work.

"It is, doubtless, not altogether an easy matter to work out these problems of partisan warfare in the vicinity of a garrison town. Those employed are too well acquainted with the ground; then, again, you are too near a large town, too much under the guns of a fortress, as it were. All these things combine to make it more difficult to set a problem and to render the solution of the same less instructive. However, these are conditions which cannot be avoided, and which one must, therefore, make the best of. * * * * *

"It will not be a bad plan to assume the existence of a state of partisan warfare, of a revolutionary movement, of the occupation of a province in small force, and so on, in order to reproduce situations of partisan warfare with some degree of probability.

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"In the time of Frederick the Great it was the custom, as is well known, particularly at cavalry stations, to have outlying picquets, at any rate, during a great part of the year, so as to accustom Officers and men to the precautions necessary on field service and to the performance of outpost duty, and though under present conditions this would be carrying things too far, and would be impracticable, yet it might be done with advantage for a few days at a time, and with the view of meeting attack from a neighbouring garrison, the arrangements for which would be kept secret. This sort of thing would make a pleasant break in the monotony of a small garrison, filling every one, high and low, with interest in their work, an interest which is often apt to flag under the influence of mere everyday drill. In this manner a proper military spirit is kept up. Another opportunity of working out problems on unknown ground is afforded by the march to and from the field of exercise, and is taken advantage of by regiments belonging to many of our army corps.

"We must not forget that many an act of partisan warfare can only be approximately represented in time of peace.

"For instance: how and when do surprises succeed?

"Against an army which is in the habit of taking proper precautions against surprise only when the men have become over-confident in consequence of the real or apparent inactivity of the enemy, or in consequence of underrating him, or when certain portions of an army have got under cover in consequence of great fatigue, extreme cold, or the long duration of the campaign, and cannot sufficiently secure themselves against attack, the

country being broken and wooded, or, lastly, when the day's march ends too late for taking proper measures of precaution before darkness comes on.

"It would have rather a comic effect if we were to assume great fatigue and so forth on the part of a body of troops which has just left its quarters, so that all we can do in this way is to give subordinate leaders a clear idea of things, and to make them understand that a detached body in partisan warfare is placed in a totally different situation to what it would be if forming part of a force engaged in great operations, that it is in consequence exposed to risks of a different character, and that the mode in which it has to secure itself from surprise must therefore of necessity be different. * * * *

"A body of troops must understand how to fight when forming part of a large combination and when isolated. Now, it is quite true that many principles apply equally to the great and to the minor operations of war, to the pitched battle and to the skirmish; but we should never forget that most of the enterprises of partisan warfare are based upon premises which are quite exceptional in great operations. Thus, in the latter, the maintenance of your line of communications will be the rule, while in the former it will be the exception.

"The elements of secrecy and concealment will not be of such influence in the latter as in the former. Tactical surprises are rare in great operations, whilst in partisan warfare success chiefly depends upon them.

"With regard to the extent of front occupied. It is certainly the correct principle not to occupy a longer front than you can hold, but in partisan warfare the turning movement is always a very important factor. Small parties can execute such a movement with a much better chance of being unobserved than large bodies. To divide your force is, therefore, under certain circumstances in partisan warfare, almost as right on principle as to concentrate it for great operations. Take the case of the intended surprise of a village. The ground favours the despatch of a detachment to attack from the west and to cut off the retreat of the garrison, whilst the remainder of the party pushes on from the south-east. It would evidently be very false criticism in a case of this sort to blame the assailant for having too extended a fighting line. And yet such a remark is often made. Hence we see how a principle applicable to great operations must needs be modified in partisan warfare.

"Here, too, the combat at Lundby serves as an illustration. Major v. Krug's detachment was greatly extended in depth, but the portion which fought at Lundby was formed quite according to regulation. In such instances, therefore, one may only fairly expect the detachment which actually comes to blows with the enemy to concentrate itself, as undue extension on its part would be as reprehensible as in great operations.

"The foregoing remarks deal more particularly with criticism and with the concoction of problems; now we will turn to their solution.

"First, with regard to measures of security. We will suppose this task to have been assigned. It belongs either of set purpose or not to the domain of partisan warfare. An Officer is detached with fifty or sixty men to perform some service; circumstances require him to wait, to keep his small party together, and to watch the enemy. What do we often see? The whole apparatus of a system of outposts. The sixty men have to furnish a picquet and not a few double sentries and non-commissioned officers' posts. The inevitable 'examining party'[1] must on no account be omitted, even if quite superfluous, and posted close in front of the main body of the picquet. If possible a non-commissioned officer's party is detached to cover the flank, numerous patrols run round and round one another about the place, and the

[1] "Examinir troop." A non-commissioned officer's party, which is sometimes useful, in rear of a picquet sentry on a main high road, for the purpose of examining bearers of flags of truce and such like before they are allowed to go further.

upshot of it is that the Officer has utterly broken up his party, and only has his bugler left. Such a proceeding may well be called the annihilation of sound judgment by routine.

"It may be excusable for a youngster, proud of what he has been learning at school, to act thus. It is a more serious matter when such a performance is allowed to pass without reproof. In many cases all that the Officer need do is to make his party lie down as comfortably as they can behind a rise of ground, to send out a patrol to each flank for security, and to post one sentry on the hill to keep a look out to the front, unless he undertakes this duty himself with his binocular.

"But people wish so often when work of this sort is done to 'have something to see,' as the saying is, whereas the proper way of doing such work, or at any rate the first part of it, is to allow nothing to be seen; in other words, secrecy and concealment are the principal things to attend to. The posting of a small detachment far in advance of the actual line of outposts with the special object of watching the enemy, of misleading him, of forcing him to premature deployment, may fall to the lot of infantry as well as of cavalry, and should be classified under the head of partisan warfare.

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"When an act of partisan warfare is supposed, measures must now and then be sanctioned which would perhaps not be advisable in a pitched battle. For instance, supposing a body of troops has succeeded in approaching under cover and unobserved to within a short distance of the enemy, and then delivers its attack suddenly and with vigour, the umpire should make some allowance, even at a sham fight, for the effect of surprise on the troops, and give his verdict accordingly.

"Another advantage of practising partisan warfare is that it may serve to stir up the men, and it must be clear to everyone who does not quite shut his eyes to the threatening aspect of things as bearing upon the future that we are bound to do our utmost to keep up true martial spirit, which must needs suffer from the mass of technicalities and refinements of all kinds with which we are now forced to deal. A good way of making our sham fights more interesting is always to make one side stronger than the other, or to strengthen it during the action, not by supposititious reinforcements, but by bringing up fresh troops suddenly, and placing them at the disposal of the director of the manœuvres. * * * *

"Reports should be handed in next morning, not later, and should only be accompanied by pencil sketches. If you want to see whether an Officer can draw well you had better set him a special drawing task for the winter months.

"Such are the measures which I should recommend as both possible and quite practicable, for preparing infantry and cavalry in peace time for partisan warfare without interfering with their training for the great operations of war.

"It is beyond my province now to speak of specialities affecting the instruction of the different arms, but I may yet mention that it is of great importance for the cavalry soldier to be able to ride across country with boldness and confidence, with due regard at the same time to keeping his horse well in hand and to saving him as much as possible.

"Far be it from me to place partisan warfare in the front rank.

"The great operations of the main armies will decide the fate of a war; still there are moments in campaigns when partisan warfare will rage because rage it must. When a nation is driven to fight for its existence (which will most probably be, sooner or later, the fate of the German people, as formerly in the time of Frederick the Great), at such a time, partisan warfare will have a large part to play, whilst it will not be entirely out of place in any war whatsoever.

"At all events, we must not quite lose sight of it and of its characteristics

even in peace time. We must look upon it as furnishing, too, the best opportunity to the Officer of inferior grade and to the non-commissioned officer for showing what they are made of, and as thus strengthening the spirit of martial enterprise throughout the whole Army, and, owing to the intimate connection between Army and people, throughout the whole nation."

Colonel v. Boguslawski concludes his remarks upon "Der kleine Krieg" with the foregoing words.

M. Devaureix, who is quite as much impressed with the importance of the subject as the German writer, has not as yet given us his views upon the training of partisans, which is to be regretted, as it would have been interesting to compare his opinions with those of Boguslawski. It is all the more disappointing as his last article in the "Journal des Sciences Militaires" of December, 1880, concluded with the following words :—

"Après avoir exposé toutes les considérations qui semblent militer aujourd'hui en faveur de la guerre de partisans, il nous resterait à rechercher quelles doivent être leur organisation et leur tactique de détail dans l'avenir. Nous réserverons cette double question pour une autre étude."

Although Colonel v. Boguslawski writes, of course, specially for the German Army, and although, much as we may admire German military institutions, we cannot help feeling that there is a good deal in them which is not applicable to our Service, yet it appears to me that there is nothing in his proposals as to "Training for Partisan Warfare," as far at any rate as I have quoted them, which might not be carried out with advantage in the British Army or in that of any other nation.—L. G.

ON THE FORTS OF TO-DAY.

By Major E. M. Lloyd, R.E.

The adoption of extended order, which is the most marked change in tactical formations during the present century, is the most marked change in fortification also. Just as the thin veil of skirmishers has grown by degrees into the fighting line of infantry, so small advanced works have gradually developed into detached forts, and become the true fighting line of a fortress. And just as military discussion is no longer concerned with the application of the oblique order, but with the handling of companies and battalions in the fight, so it has drifted away from rival systems of fortifying an enceinte to the position and organization of forts. The cause in both cases is the same: increased effect of fire, and diminished apprehension of shock.

It was in field fortification, where there was no great inequality between the combatants, that continuous lines first went out of fashion. Successive improvements in small arms, such as the introduction of the flint-lock fusil, paper cartridges, the iron ramrod, and the socket-bayonet, made infantry stand less in need of a material obstacle to protect them against horse, and allowed of handier formations and greater mobility. Troops on the defensive could not afford to leave the whole benefit of this to their enemy, and restrict themselves to a passive defence. At Pultowa and Fontenoy the example was set of fortifying a position by a chain of redoubts, giving freedom of counter-attack; and the method rose in favour as time went on till its reputation was established by Torres Vedras and Dresden. In permanent fortification the movement in the same direction was necessarily more cautious. Vauban was blamed for the redoubts which he placed on the high ground east of Namur,

The Plate to Major Lloyd's article on "The Forts of To-day," will be issued with the July Number of the Journal.

though they delayed the besiegers for a fortnight in 1695. Marshal Saxe, instead of such redoubts, wished to surround a fortress by a chain of masonry towers. Montalembert combined the towers with the redoubts, and proposed to secure Cherbourg from bombardment by a double chain, of which the outer works were 2,000—3,000 yards from the place, and 1,400—2,000 yards apart. But his critics confidently asked what was to prevent a besieger from sapping round and isolating them; for even "when redoubts and lunettes, provided with countermines and susceptible of a good defence, are at the foot of the glacis of a besieged fortress, one does not consider their communication with the place secure unless it is by an underground gallery."[1] Even such a gallery did not save the Queen's Redoubt, in front of Fort St. Philip, in Minorca, from being stormed in 1756, though it allowed the garrison to escape, to surrender with the fort next day. The surprise of Schweidnitz in 1761 increased the mistrust of outlying works. On the other hand, at Cassel, in the following year, "a simple earthen redoubt, 1,000 yards from the fortress, obtained all the honours of a regular siege. The besieger, after spending eleven days of battering and sapping upon this redoubt, at length ventured to assault it; the French, who were defending the redoubt, stood the assault for more than an hour, and at length, with the help of reinforcements from the place, repulsed it with great loss to the enemy."[2]

D'Arçon, afterwards a prominent figure among the French engineers, took part as a young Officer in the defence of Cassel, and laid its lesson to heart. In his well-known work, published thirty years later, he proposed the question, "not merely whether detached works should be allowed as an addition, that seems evident enough; but whether, supposing a simple enceinte is to be strengthened, one should not prefer these exterior dispositions to a multiplication of works accumulated upon the enceinte."[3] He laid stress on their importance, as Montalembert had done, for protecting naval arsenals from bombardment, for which purpose they must be thrown forward a mile and a half or more. But he recommended them also for ordinary fortresses which would have little to fear from bombardment, and where they need be only about a quarter of a mile from the covered way. He built, not so much on the delay which their capture would impose, as upon their influence on the *morale* of the garrison, and the activity of the defence. Troops, as he said, were always apt to lose heart and think of surrender as they watched their enemy occupying commanding points, tightening his grip round the fortress, establishing himself on the crest of the covered way, and opening a breach in the body of the place. Detached works, while hindering each of these steps, would also allow the men's courage to be kept up by frequent sorties without risk of their retreat being cut off; and if these sorties were combined with a vigorous use of countermines the defence might be prolonged indefinitely. His Cassel experience had taught him the importance of keeps in the interior of detached works, and of good flank defence for their ditches; and both of these are provided—the former by a loopholed circular tower, the latter by a counterscarp gallery—in the excellent type of work known as the "lunette d'Arçon," of which examples were to be found lately both at Metz and Strassburg.

The detaining value of detached works was exemplified in the two British sieges of Badajoz. The first consisted mainly of an unsuccessful attack on Fort San Cristoval; in the second more than a week was spent in the capture of the Picurina lunette. But the siege of Colberg by the French in 1807 furnished a more striking instance. Gneisenau, then only a Major, was sent there to direct the defence. In presence of the besiegers he threw up a field-

[1] "Mémoires sur la Fortification Perpendiculaire."
[2] D'Arçon, "Considerations Militaires et Politiques sur la Fortification."
[3] *Op. cit.*

work on the Wolfsberg, more than 1,000 yards in front of the covered way, to serve as the main pivot of an advanced line. Before it was finished it was stormed by the enemy, but it was recaptured before morning. The French then opened a systematic attack upon it, and after a siege of twenty-five days the work was surrendered, as it had been so much injured by that time that it was unfit to stand another assault. Three days afterwards a sortie was made and the garrison once more got possession of it; but it had to be abandoned next morning, after the gorge had been partially thrown open. Another sortie four days later was repulsed with serious loss, and from that time the defence had to be more passive; but in another fortnight, while the fortress still held out, peace was concluded.

The feebleness of small old-fashioned fortresses as ordinarily defended, repeatedly illustrated throughout the Napoleonic wars, had been brought out with special prominence in 1814–15; and after Waterloo, a strong current of opinion soon showed itself in favour of fewer and larger fortresses. Rogniat led the way in 1816, with a proposal to convert places of strategic importance into intrenched camps capable of receiving an army of 100,000 men by adding four forts, one on each side of the place, and a mile and a half from it. Four battle-fields would thus be presented to the enemy, each about three miles long, perfectly secured on the flanks, and strengthened by field-works in the centre. The problem of fortifying Paris gave practical interest to the question, and after twenty years of controversy between the advocates of detached forts and those of a continuous enceinte, it was decided in 1840 to provide both.

Meanwhile, in Germany, this solution was more promptly and unanimously arrived at. The most important fortresses on the Rhine, Cologne, Coblentz, Mayence, and Rastadt, were converted into intrenched camps by the help of detached works, and the same thing was done with Verona, Ulm, Olmutz, Cracow, and the places on the east frontier of Prussia; while at Lintz an intrenched camp was formed by a chain of towers without any interior enceinte.

The character of the German works and the principles on which they were planned were explained in a memorandum by General von Brèse, the designer of the works of Posen.[1] When a position is to be fortified, the engineer, he says, makes choice of the most important points, and on these he places round or angular towers, forming casemated defensible barracks of two or three stories, with a gun-platform on the top. These towers, secure in themselves against a *coup de main*, are sheltered from direct artillery fire by earthen ramparts in front of them, upon those sides on which an enemy could place batteries. Thus they form the keeps of works, sweeping the interior with musketry from their lower story, and the terrepleir of the ramparts with artillery from their upper story, while the gun-platform on the top commands the country as a cavalier. The upper story can also be used for howitzers to shell the siege-works. The ditch in front of the earthen rampart is flanked by caponiers or counterscarp casemates; and, unless the work is exposed to fire on all sides, the gorge is closed merely by a wall, so that other works in rear may fire into it if it should be taken by the enemy. The Cologne works of this type were placed about a quarter of a mile in front of the enceinte, and rather more than that distance apart.

A chain of such works, General von Brèse argued, is not only cheaper in construction, garrison, and armament, than a corresponding length of bastioned enceinte, it opposes a resistance three or four times as great, since each work must be taken separately, and above all it gives every facility and support to the offensive strokes of the garrison.

[1] Extracts from this memorandum were given in the "Royal Engineers' Aide-Mémoire to the Military Sciences."

As soon as rifled artillery was introduced, it was seen that the great increase of range and accuracy made detached works at once more necessary and more effective than they had been hitherto, and they were employed on quite a new scale. In 1859, immediately after the peace of Villafranca, Verona was provided on the west side with an outer chain of forts, 2 miles in advance of the enceinte, and rather more then 1 mile apart. The new fortifications of Antwerp comprised a chain of forts which were similarly placed, but were of much greater size, having a crest line of nearly half a mile on the front and flanks, and an armament of 120 guns.

In the English defence works undertaken at the same time, they played a still more prominent part. "When the extent of the positions necessary to be occupied in order to protect the dockyards against long-range bombardment is considered, it is evidently impossible," it was said, "to occupy them by continuous lines, which must be manned throughout their whole extent, and which fall if pierced at any one point."[1] The forts in some cases had to be thrown forward 3 or 4 miles, so that they must needs depend wholly upon themselves, without any support from an enceinte in rear. They were rather nearer to one another than the Antwerp forts, and had only about half the length of crest line. While of the same general type as the German forts, more care was taken to place their caponiers in such positions that they were not liable to be silenced by fire along the ditches they flanked.

In England, as before in France, the new fashion of fortifying did not meet with unanimous approval, in spite of the fresh arguments in its favour. Just as conservative soldiers, even after the Franco-German war, still refused to admit that "our two-deep line formation, so long regarded as a thoroughly British institution, must be looked upon henceforth as impracticable, and that the German skirmisher-swarm formation must take its place," so others ten years earlier refused to admit "that mere fort building is fortification," and asked for "a good wholesome wall and ditch which the enemy has to get through or over before he reaches his object." A very able Officer —Colonel Owen—tried to show that a continuous line, which "has been well and fully tried for thousands of years," is as cheap as a line of detached works; that it can be defended by fewer men and those men far less trained; that its defence is simpler and easier understood by Generals, by Officers, and by men; and that it appeals most to the patriotism of the citizens.

But his vigorous argument failed to win much support, and in the discussion which he started the weight of authority was all against him.[2] It was generally agreed that to guard a very extended line with a small force, the essential thing was to make sure of the commanding points. If these were strongly fortified and held, little was to be feared from an enemy pushing between them. Connecting lines would be of more or less value according to circumstances; but a simple continuous line of many miles would be as ill-adapted to passive defence by a mixed garrison as to active defence by an army of disciplined troops. As regards the relative expense, there was the broad fact that the enceinte of Paris, though of the simplest kind, without outworks and with an unrevetted counterscarp, had cost 25 per cent. more than the chain of forts, the perimeter of which was more than half as much again.

The real gist of the question is well brought out by one of Colonel Owen's illustrations. "When a farmer puts up a fence or a wall round his garden, he erects a fortification; and so long as fortification is a development of that one simple idea, everyone can understand it. When you put up a row of forts

[1] "Royal Engineer Professional Papers," vol. ix.

[2] "Royal Engineer Professional Papers," vols. xii and xiii. Another advocate of continuous lines has lately come forward, but only to follow in Colonel Owen's track. See "Occasional Papers of the Royal Engineers' Institute," vol. iv.

and say the enemy cannot pass through, it is asking the farmer to believe that the posts of his fence will keep out cattle without the rails." But the parallel shows how completely the engineer may lose sight of the tactician. The fence has to keep out the cattle by itself; but it is not the works, but the troops inside of them, that will have to keep out the enemy. The question is, how they will be best posted for that purpose: in a long thin line, or in compact groups? The armour must be made to fit the man, not the man the armour.

Colonel Owen took exception, not only to the open intervals, but to the closed gorges of the forts. He confidently asked whether, supposing an engineer had the time and means to strengthen further a place already fortified by a continuous line, he would intrench the salient points inwards, or in other words, convert them into forts. "Surely not," he said, "would he not rather make coupures in his own rampart, and retrench against the enemy those points most liable to be breached, or where from exceptional circumstances an escalade might be apprehended?" The course of the American Civil War was just at that very time throwing some light on this point. General Abbott, of the United States Engineers, in his remarks on the operations against Richmond, dwells particularly on the advantage derived from insulating the vital points of the line. "Our system of intrenchments at Petersburg," he says, "consisted in general terms of a system of field-works, each capable of containing a battery of artillery, and a strong infantry garrison. These works were closed at the gorge, were protected with abattis and palisading, were often supplied with bomb-proofs, and were located at intervals of about 600 yards, on such ground as to well sweep the line in front with artillery fire. They were connected by strong continuous infantry parapets, with obstacles in front." Early one morning, three Confederate divisions swept across the lines on either side of one of the weakest forts, joined in rear, and carried it; but they could take no others. As soon as daylight would permit, all the artillery that could be concentrated opened on the work which had been taken, and which the enemy still held. "No reinforcements could join him from his own lines, owing to this fire which swept his communications; his captured position was entailing deadly loss; our reserves were rapidly assembling, and finally, about 8 A.M., they made a charge which resulted in the recovery of our works, of all our artillery, and in the capture of over 1,800 prisoners."[1] The result was very different in some of the assaults upon the Confederate lines, where the works had open gorges, and such an extent of line was consequently occupied, that the assailants could not be driven out again.

What applies to field-works applies equally to permanent or provisional works. German engineers, from Von Brèse to the present day, have laid it down that in most cases an enceinte will be best formed by placing works of the same general type as detached works upon the most important points, and connecting them with one another by simple lines; and this was the mode adopted in the bridge-head of Florisdorf, thrown up in 1866, to protect Vienna.

The varied siege experience of the Franco-German War brought out fresh reasons for extending the circle of defence of fortresses, both large and small, and consequently for relying more upon forts. The blockade of a fortified capital, like Paris, proved by no means so vast an undertaking as had been predicted. Instead of requiring five or six times the strength of the garrison, as Colonel Brialmont, for instance, had estimated, it was found that a garrison of 200,000 regulars and mobiles (besides national guards) could be securely invested by an army actually inferior to it in numbers, extended over a circuit of nearly 50 miles.

[1] Abbott, "Siege Artillery in Virginia."

The chief object of the new fortifications of Paris is to make such an operation more difficult in future by robbing the enemy of those commanding sites which proved so useful to him, doubling the length of his line of investment, and embracing large areas of camping ground and pasture. There are three principal masses of high ground, upon the north, the east, and the south-west of Paris. Possession of these masses is now secured by the new forts which form three separate camps, "three tactical centres," and are from 6 to 10 miles in advance of the enceinte. How far more formidable a work another siege of Paris would be, is fully recognized by the Germans themselves. A recent writer in the "Militair Wochenblatt" (August, 1880) points out all the difficulties of the task: from the extension of the works, their advantages of position, their excellent construction, and powerful armament, the circular railways which "give the Commander-in-Chief a freedom of action without a parallel in military history," and the immense resources of the city. "One cannot expect that, as in 1870, the French armies will disappear from the scene, but must rather assume that there will be time enough for a large army to be collected for the defence of Paris," especially when we consider the spider's-web character of the French railway network. While a continuous investment would be a gigantic task, he thinks it very questionable whether, as has been proposed, an effective blockade could be maintained by armies concentrated on different sides, and linked to one another by cavalry divisions. But "the defence of this vastest of all fortresses must be planned and executed upon a grand scale, and requires military genius of the highest order," and the doubt whether this would be forthcoming is the chief consolation which the writer offers to his countrymen. But, as the same writer adds, "it is not only round Paris that the observant German soldier sees the circle of defence growing wider and stronger; besides the new intrenched camps of Epinal and Belfort, Langres, and Besançon, the lines of La Fère, the fortified position of Rheims, the fortresses of Verdun and Toul, girdled with strong new forts, the fortified plateau of Haye, the permanent works which guard the Moselle near Nancy, and those which lie on the Meuse, upon the north-east frontier, the entry of an enemy in another direction is opposed by the intrenched camp of Dijon in the Côte d'Or, and by that of Lyons further south. If the above-mentioned works of defence and lines are only in part new creations, yet it is solely by the extension they have received, their solid construction and suitable armament, that they have become factors full of importance, which must be taken account of in those large calculations on which hangs the weal or woe of nations. One stands amazed when one considers that that same France which lay so low in 1871 is now able to call out much more than a million of men to defend their country, and that all the above-mentioned measures of defence have been carried out, with a silence quite unlike the French wont, and are now nearly finished."

What chiefly concerns us here in these defences is to notice the almost complete disappearance of those small fortresses for about 5,000 men, which, from Vauban's time down to 1870, stood like picquets extended along the French frontier. Instead of them we see a series of camp-fortresses[1] with barrier-forts between them. Montmédy is to be reduced, it is said, to the latter class; while Toul, Langres, and Verdun have been converted into camp-fortresses of ten times their former diameter. Toul proved very useful in 1870, blocking a main line of railway for six weeks, owing to the German inability to bring up a siege-train at that time; but, like Verdun, Thionville, and so many other places, it surrendered without waiting to be regularly besieged. The convergence of fire from all quarters, to which their small

[1] The Austrian term "camp-fortress" seems preferable to the German term "fort-fortress." One can speak of the component parts as camp-forts, instead of as forts of a fort-fortress.

radius exposed them, made defence hopeless. The long and successful resistance of Belfort was mainly due to the bold maintenance of outlying positions. Apart from the reasons that have been given already, the favouring of an active defence, the occupation of valuable sites, the protection of buildings from bombardment, and the enhancement of the difficulty of blockade; looking merely to the conditions of the artillery combat, rifled guns have made it all-important to enlarge the circle of defence, so as at any rate to escape reverse fire.

In some cases, as at Antwerp and Strassburg, the nature of the ground is likely to forbid complete envelopment, and there may be fair hope of reaping the full value of a strong enceinte by an obstinate defence at close quarters; but elsewhere, though it may be well to have some continuous obstacle to bar entry into the town which forms the heart of a fortress, it may be doubted whether it will be found worth while in future to create a siege-enceinte. What used to be said of the covered way—"covered way lost, all is lost"—may now be said with equal truth of the line of forts. That is the line which it is the most essential and easiest to defend, and nearly all the available resources should, therefore, go to reinforce it. The idea of the Prussian engineers of the last generation, that a fortress, like a spiral spring, should offer more resistance the more it is compressed, must be discarded as hopeless in presence of rifled artillery.

Some nucleus (*noyau*) is certainly desirable for every large fortress, but this may be not in its centre, but on its border line, like the citadels of former days; some particular region of marked natural strength or importance being constituted as an independent camp, defensible on all sides. The small camp first formed at Langres may be said to stand in this relation to the much larger camp since formed by the new forts to the north and east, two of which are 7 miles from the place.

General Brialmont goes further. He recommends that the plan of grouped camps which has been actually adopted at Paris should be the normal disposition for the fortification of a capital. He gives as a type three similar camps symmetrically placed on a belt nearly 6 miles wide, and lying at about the same distance outside the city. Each camp would be roughly about 14 miles by 6, and might be formed by ten forts—five upon the front, three on the gorge (towards the city), and one at each end. The intervals between the camps would be about 9 miles. He considers that though the cost would be greater than that of a simple line of forts, the defence would be much more protracted, and there would no longer be any necessity for a guard-enceinte round the capital, a thing most important to avoid with a vast and growing city like London.

"There is a bold and tactical air about this method of fortifying; holding the enemy off by threatening his flanks instead of barring his front. It looks at first sight like a larger application of the principles which have substituted detached works for continuous lines. But there is the all-important distinction that such works are assumed to be within range of each other, and that these camps are not. The combat is to be one of weeks and not of hours, so that the enemy can afford to push his way forward cautiously in the intervals upon a front of 6 miles, intrenching himself against flank attacks. Once within range of the capital it must fall into his hands, for any show of resistance would bring bombardment upon it. The defending army, if the war is not ended, will find itself cut in three, and its camps will be open to attack on whichever side the enemy may prefer. It may be said that the intervals would be occupied by field-works; but the comparative inadequacy of field-works, which is the ground for all permanent fortification, applies here as much as elsewhere. No doubt, with so extensive a circuit it would be well worth while to retrench some one part to serve as a citadel; but leaving one of these camps as it stands for this purpose, one cannot help thinking that the

half-dozen works which guard the rear of the other two camps would be better placed by pairs in the intervals." [1]

However well such a disposition may apply in a particular instance, such as Paris, where there was not only an enceinte for the city, but gorge forts for the camps ready to hand, it seems very questionable as a general type. As Brialmont himself points out in another connection:—"The action of a fort on the ground in front of the neighbouring forts will be greatest where the forts are in a straight line, or in one that is very slightly convex. One should avoid as much as possible, therefore, placing the forts in such a way as to form pronounced salients and re-entering angles."

With the exception of the works at Paris, the forts lately built have, as a rule, been placed within 3 miles of the enceinte. It has been recommended by Brunner[2] and Brialmont[3] that this distance should be increased to 4½ miles, in order absolutely to preclude bombardment of the town. But the increase in cost of construction, and in the strength of garrison, involved by such an extension of radius has to be set against this advantage. Also, as the distance widens, the area of intervening ground unseen from either forts or enceinte, and affording shelter to an enemy who has passed between the forts, will become greater; in one of the new French fortresses there is said to be more than a square mile of such ground. Such an advance will sometimes be necessary, however, in order to see the ground in front better, as on the south-east side of Verdun (which is probably the fortress just referred to), where one of the principal forts is more than 4 miles from the enceinte; and occasionally it may even reduce the length of line to be defended, as in the Anthony position at Devonport.

It is beginning to be accepted as a principle that the distance of forts from one another, instead of 1 or 1½ mile, may be 2½ or 3 miles, if the ground is open; in other words, that it is enough for them to defend the intervals between them, instead of affording effective mutual support. This has been acted upon in many of the new fortresses, especially in France. Between the St. Cyr and Palaiseau Forts (on the south-west of Paris), which are more than 10 miles apart, it has been thought sufficient to provide two others. The country round Verdun is broken and wooded, and there eleven works have been made for a perimeter of 25 miles, the intervals varying from 1½ to 3 miles. One reason given for this wide spacing is to economize garrisons, and to avoid breaking up the defence into many fractions. But the duty of guarding intervals of 3 miles could not fail to be made lighter by the existence of storm-proof posts in the middle of them; and the writers who give their sanction to such long intervals (*e.g.*, Brialmont, Brunner, Von Bonin) assume some such small intermediate works, either permanent or provisional.

"It is well known," says a French engineer,[4] "that in the fortresses as they now stand, both in France and abroad, the extent of the works has been limited by financial considerations; and, therefore, in most cases only the most important points round the fortress have been fortified, and the completion of the defences has been postponed till the time of need. . . . The Germans have placed the forts thrown up round Strassburg[5] and Metz at average intervals of 2 to 4 kilomètres, as they consider those places to be too much in front line to allow the making of intermediate works to be put off till war breaks out: on the other hand, for the forts of their places in second line they have been satisfied with the intervals of 5 or 6 kilomètres adopted

[1] "Royal Engineers' Journal," March, 1874.

[2] "Défense des États," (1876), pp. 141, 143.

[3] "Beständige Befestigung," (1876), p. 154.

[4] "Étude sur la Fortification semi-permanente." Par un Officier du Génie. (1880.)

[5] Strassburg has fourteen forts; those on the south and east are 4 kilomètres, but those on the north-west are only 2 kilomètres apart.

in France. This shows that they mean to throw up intermediate works there when needed, and that they admit the principle of mutual flanking at effective ranges, a principle which is equally admitted in France."

The projects for such intermediate works have, according to this writer, been already got out, but he estimates that 500 or 600 men would be occupied two or three months in making one, and reasonably urges, therefore, that France should follow the example of Germany, and build them in time of peace for her frontier fortresses.

But if it is desirable that they should be permanent works, one may further ask whether the maxim does not hold good here as elsewhere, that "a chain is no stronger than its weakest link," and whether—apart from peculiarities of site, which will continually give more importance to this fort, and less to that—it should not be the general rule to equalize the several links, instead of making them weak and strong alternately. "The garrison of a large fort consisting of 1,500 to 1,800 men, commanded by a Colonel, will usually have a better spirit and be more ably handled than that of a small fort consisting of 300 to 400 men, commanded by a Captain or a Major."[1] On this ground General Brialmont has always been the advocate of large forts, and prefers to reduce their number rather than their size; but whatever weight this argument may have against small forts, it must have much more weight against the still smaller intermediate works (intended for 50 or 60 infantry and 3 or 4 light guns, according to General von Bonin), which it is proposed to place in the wide intervals between the forts. The French engineers lean to Brialmont's views. The principal forts of their new camp-fortresses have infantry garrisons of 1,000 men and mount 36 guns on the ramparts. Some of the Paris forts mount 60 guns, while some of the isolated barrier forts mount from 80 to 100, and are constructed for 2,000 men or more. The German engineers lay less stress on size. They are satisfied in most cases with infantry garrisons of 500 men, and with 20 guns on the ramparts. When more guns are needed at any particular point, they can be placed in wing batteries, without enlarging the forts. If the Germans are right, forts may be placed at a mile and a-half apart without absorbing more than one-third of the entire garrison of the fortress, reckoning this, as is generally the case, at about 1,000 infantry per mile.

Passing now to the construction and organization of individual forts, it will be best first of all to borrow a general description of one of the new German forts,[2] such as those of Strassburg, to serve as a point of departure and comparison for others.

"The detached forts of the chain round a great place of arms are usually of lunette shape with very obtuse salients (130° to 145°), in order that the faces may escape enfilade, and also that their frontal action may be better, since they have to hold their own against the besiegers' batteries in the first encounter. The direction of the flanks depends on the position of the collateral works, but is, as a rule, nearly parallel to the capital. Assuming the forts to be a long way from the enceinte, their gorges may be closed by a line of rampart either of bastioned or of slightly re-entering trace.

"The size of the forts is proportioned to the part they have to play in the general system of defence. The faces will commonly be 75 to 125 mètres, the flanks 50 to 70 mètres in length, so that the perimeter of the forts will considerably exceed what it used to be, just as their present importance does.

"In a detached fort the use of the covered way is not so much to facilitate sorties, which can be made more conveniently upon the flanks, as to allow of keeping sentries outside the work up to the last stage of the defence; it can be replaced, therefore, by a simple patrol path, which on the gorge side

[1] "Défense des États," p. 143.

[2] Bonin, "Festungen und Taktik des Festungskrieges" (1878).

becomes a roadway to the wing batteries (*Anschluss-glacis*), and widens out opposite the gorge gateway into a place of arms, with a tambour and a block-house to guard the communication. By this arrangement of the covered way, together with admissible reduction in the width of the ditch, it becomes possible to screen the masonry escarp of the faces and flanks from the besiegers' indirect fire, provided it is limited to a height of about 5 mètres. Since this height in itself affords no sufficient security against assault, and the situation of the forts—usually on commanding ground—seldom allows of wet ditches, such security must be sought for by means of good flank defence for the ditches, and of a high revetted counterscarp, perhaps organized for counter-mines. The escarp of the gorge, not being exposed to the heavy batteries of the attack, will be utilized for shelter-casemates, and revetted to a suitable height.

"The double caponiers at the shoulders which were formerly used to flank the ditches of lunettes are no longer admissible, as they could be destroyed by the enemy's indirect fire on the prolongation of the ditches of the faces. They are usually replaced by a caponier at the salient, sweeping the ditches of the faces with artillery, and two single caponiers at the shoulders, on the prolongation of the escarp of the faces, sweeping the shorter flanks with musketry. If the gorge has been given a bastioned trace, casemated flanks furnish a low flank-defence for its ditch; if it has been simply broken inward, a caponier is required. All caponiers have posterns leading to them from the interior of the fort.

"The old reason for providing the escarp with a costly revetment wall, to bring the musketry fire as near as might be to the crest of the glacis, has no longer any weight with the new rifle; it is now thought better, therefore, for the sake of economy, to have an earthen slope for the escarp of the rampart of the faces and flanks, and to place a less substantial detached wall at the foot of it as the obstacle to assault.

"The command to be given to the rampart above the plane of site depends upon the formation of the ground in front, which should be overlooked as extensively as possible; it will seldom be less than 8 or 9 mètres. The greater penetration of the new siege guns requires that the thickness of the parapet should be increased to about 7 mètres. A less command will suffice for the gorge parapet; it is enough that it should cover the faces and flanks from reverse fire in case of assaults; and here, as the direct fire of heavy siege guns has not to be met, the thickness of the parapet may be reduced to 4 mètres.

"The rampart will from the first be organized for guns upon the faces and flanks. On the gorge it will be prepared only for musketry, but in the later stages of the defence it may be necessary to mount guns there also; and accordingly the terreplein must be made wide enough for them. . . . .

"The employment of casemated batteries for fire to the front has had to be given up; the bombproof gun-emplacements of masonry or timber which were formerly in use, can be used no longer, owing to the accuracy and destructiveness of the new siege artillery; it has been found necessary to sacrifice the howitzer fire upon the country which was to be furnished by the upper stories of casemated keeps, since such action of the keeps could not be reconciled with their own protection from indirect fire. But this protection has further required in most cases that the command of the interior of the work from the casemated keep should also be sacrificed, since if it was to fulfil its object in this respect it could not be shielded against an angle of descent of 10°. There was naturally great reluctance to abandon the casemated defences which had been thought so much of, and attempts were made to reinforce them by iron plating, as had been successfully done with ships-of-war. But the results of these attempts were not very satisfactory. The conclusion has had to be accepted that casemated defences are only to be

employed where, owing to the nature of the site, they can be protected even from indirect fire. . . . .

"The importance of the rampart as the main line of defence has become more distinctly marked, and has demanded better measures for securing its defensive powers. With this object the gun emplacements and roadways along the ramparts have been sunk lower, in order to get better cover; higher carriages have been adopted for the guns firing overbank to repel assaults; while indirect fire is chiefly contemplated from those which are intended for the artillery combat in case of a regular siege, since the deep embrasures that have been used hitherto cannot now be employed, on account of the accuracy of the new artillery. More complete traverse-cover has been given to guard against side shots; only one gun being placed between a pair of traverses on lines exposed to enfilade, and on other lines at most two guns. Secure receptacles for ammunition for immediate use have been made in the interior slope, or in the traverses; and the latter, being built hollow, with a sufficient thickness of earth over the masonry on the enemy's side, allow the troops on duty upon the ramparts, and even some of the lighter guns provided against an assault, to take shelter in them if the enemy's fire should be very heavy. . . . .

"The quarters for the garrison in general lie as a rule in a range of casemates along the gorge, which also contains the hospitals (essential for the self-dependence of the several forts), and in the basement, kitchens, stores, &c. For guards and other detachments held in readiness, casemates open to the rear and well provided with outlets are made under the terreplein of the faces; in case of need the space afforded by the posterns will either supplement these or serve instead of them. This space will also be sufficient to contain some of the stores which are not immediately required for the defence, and which ought to be sheltered from the enemy's fire. . . . .

"Each fort requires at least one main powder-magazine, completely in the heart of the rampart, and quite out of reach of the enemy's fire, and, according to its size, two or three shell-filling rooms, each with its own expense-magazine and the necessary storerooms for the several kinds of artillery ammunition. . . . . These are placed under the terrepleins, and are connected by lifts with hollow traverses overhead, so that the made-up ammunition can be transported without risk from the enemy's fire almost to the very spot where it is to be used. Lastly, the increased effect of siege artillery imposes greater care about the communications. This is partly met by the larger use of traverses on the terrepleins; but with . . . . detached works one cannot do without large capital, or central, traverses, which divide the interior of the work into separate portions, protect the several lines of rampart from indirect reverse fire, and at the same time allow a completely sheltered communication to be made between the gorge and the casemates under the main rampart. With very exposed works one may even go so far as to carry this covered communication right along the ramparts, and connect it by staircases with the hollow traverses on the terreplein, so that if the enemy's fire is heavy and convergent the open area of the work and the ramps to the terreplein need not be used at all for circulation."

Much of the above description would apply to any of the recently constructed forts, whether in Germany or elsewhere. The points which chiefly call for remark, and regarding which we find most difference of treatment, are:—

(*a.*) The general shape of the fort,
(*b.*) The provision of a keep,
(*c.*) The disposition of the rampart armament and the mode of mounting it,
(*d.*) The caponiers.

General Brialmont in his latest type (Planche II), as in the forts of Antwerp,

has preferred a single straight front, or head, to the two faces of the more usual lunette form. His objection to the latter is that they bear less directly upon the ground over which the besieger will advance, and that they are likely to be enfiladed from the salient towards the shoulders. When a work occupies a re-entering position in the general line, so that the prolongations of the front ditch cannot be taken up by the enemy, the straight trace has everything to recommend it. For one thing, its caponier may be placed at one end instead of in the middle, and will be able to defend also the adjoining flank, thereby saving a shoulder-caponier (as in the case of Fort Purbrook, a plan of which is given in vol. xii of this Journal). This will also allow such a trace to be adopted in cases where one only of the prolongations lies out of the enemy's reach. But Brialmont himself recognizes that the front must be broken outwards whenever the enemy could otherwise place batteries so as to breach the caponier by firing along the ditch. The forts of a camp-fortress must as a rule be salient works, and their saliency increases as the intervals between them are made wider. Even if the siege batteries are not strictly on the prolongation of the ditch, but 10° or 15° outside of it, their shot will still drop sufficiently after clearing the glacis to strike the masonry of the caponier. So far as the escarp line is concerned, therefore, it seems likely that as breaching by curved fire becomes more perfect the angle between the faces, instead of being increased to 180°, will commonly have to be made less obtuse than hitherto; and if this makes the fire of the two faces too divergent, or exposes them too seriously to enfilade in the opposite direction, some part of them must be traced independently of the escarp.

In some cases, as in the type given by Major Wagner, of the Prussian Engineers (Atlas, xviii, 20), secondary flanks are provided, firing to the right and left rear, so that the work fronts three-quarters of a circle, and the gorge is narrowed. In very salient positions such a form is imperative, and even for the ordinary forts of a chain it has the advantage that, when their neighbours have fallen, and the enemy pushes in through the gap, they themselves cannot so easily be taken in rear, and are better able to support a retrenchment line. But these secondary flanks are themselves so exposed to reverse fire, that they need to be protected by parados, or to be completely casemated. They help to hide the keep, when there is one, as in this instance, from the enemy's view; but that seems a questionable advantage, as they correspondingly restrict its action.

The new French and German forts have been made without keeps, on account of the difficulty already mentioned of making them effective for their purpose, and at the same time sheltering them sufficiently from curved fire. "They restrict the interior space," says Major Brunner, "and intercept the shells which fly over the parapet of the work, so that they are liable to be disabled along with it. Consequently their services are not always in proportion to their cost."[1] Another Austrian writer says: "Although keeps can be protected from curved fire in the same way as the main work, it must be remembered that the keep has usually no action upon the ground outside, and that if once the outer line of the fort is carried, the pushing forward of an attack step by step on the keep, though it presents difficulties and occupies men, causes no serious hindrance to the progress of the attack against adjoining works, or against the nucleus."[2]

But other writers still insist on their importance. "To renounce a keep," says Wagner, "would be as incorrect as to fight in the field without reserves."[3] He endeavours to adapt the old Prussian type of keep to present conditions, retaining even the casemates for high-angle fire. Instead of over-

[1] "Beständige Befestigung," p. 89.
[2] Weeger and Geldern, "Befestigungskunst" (1873), ii, 36.
[3] "Grundriss der Fortification" (1872), § 129.

lapping the gorge ditch, it must now be pushed forward into the interior of the work, and its escarp covered by an inner glacis. Its platform must not be given any command over the main rampart, but one or more iron turrets may be placed on it, to fire indirectly upon the country.

Brialmont maintains that "a keep is an indispensable work for every important fort which is either isolated, or in a salient position."[1] It is not really costly, for it furnishes the casemated cover which must needs be provided in some form, and by the additional security it gives, it may even allow of a reduction in the height of the main escarp and counterscarp. The space it occupies is useless for any other purpose, and it does not necessarily involve any enlargement of the fort. If properly constructed, instead of falling with the fort, it will impose a second siege on the enemy, and will meanwhile arrest his further advance ; for, unlike Wagner, Brialmont makes it an essential condition that the keep should overlap the gorge ditch, and while screened from the front by the main rampart, should be able to command the country on either flank as well as to the rear. He dwells upon the value of the keep, not only in guarding a fort against sudden capture by assault, but also in supporting counterstrokes for its recovery when the enemy have got possession of it. With this contingency in view, he would make wide roadways across the gorge ditch and rampart, close under the guns of the keep, to allow the fresh troops to enter the work.

Since he wrote, a marked instance in support of his argument has been furnished by the storming of Kars. When the Russians had made themselves masters of Fort Kanly, the fire from its keep, a defensible barrack, obliged them to abandon the interior, and get cover outside the parapet. It enabled the Turks to reoccupy the work for a time, and when they had retired the keep still held out, until all the works on that side of the river had surrendered, and it was plain that further resistance was useless. It must be remembered, too, that Fort Kanly, like the other southern forts, had been vigorously bombarded with siege guns for a week before the assault.

The main problem in fort building—how to organize the ramparts and dispose the armament, so as to deal either with the converging fire of numerous siege batteries, or with sudden assaults by overwhelming forces—meets with widely different solutions. In most of the German forts, as already mentioned, reliance is placed chiefly upon the use of high carriages, and of massive and frequent traverses. There is only a single rampart, on which the heavy guns are mounted for indirect fire during the artillery combat, and which serves for infantry, or for the lighter guns firing overbank when the enemy comes near. In the French forts there are two ramparts, a lower one for infantry, and a higher one behind it for artillery, so that 600 rifles and about 30 guns can be brought into play at once. This arrangement is said to have been adopted also by the Germans in some of their latest works, but Brialmont condemns it because the infantry would suffer so much from shells bursting in the exterior slope of the rampart in their rear. He himself recommends an inner rampart for the heavy guns, but it is lower than the outer rampart, and screened by it from the enemy's view.[2] In large forts with keeps, this inner rampart should be broken into two halves, separated by the keep, which should flank them both in front and rear ; in small forts it will form a continuous retrenchment or parados for the gorge parapet.

An interior battery of this kind has been adopted in the latest English type of fort (See § 292, Part I of the Woolwich "Text-book of Fortification").

[1] "Défense des États," p. 185.

[2] General Todleben carried out some experiments in 1875, which led him to the conclusion that, as indirect laying must in any case be largely employed in future, part of the armament should be placed behind the main rampart instead of upon it.

The crest is about 60 yards behind the outer parapet, and half a yard below it, and the exterior slope is very gentle, so that shells striking it may ricochet over the work. The outer rampart is intended only for musketry and field-guns, with a few heavy guns on Moncrieff carriages at the angles.

In the newest Austrian designs, given in the magnificent collection of details of military architecture recently published,[1]—a collection to which one would much like to see some English parallel—we also meet with interior batteries, with their crest on the same level as the outer crest, or a few inches higher. In one case the battery forms part of a keep. The ends have a masonry escarp screened by an inner glacis, and they form orillons covering the flanks of the keep, which have a good view over the country upon the sides, and in rear of, the fort. The front has only a steep earthen slope, with an unflanked palisade at its base.

Iron turrets and shields have been made use of to some extent abroad for inland works as well as for coast batteries. The earliest turret mounted on land was on the keep of one of the Antwerp forts, and some of the new forts at Metz are provided with two turrets each. The cost has been brought down as low as 4,000*l*. for a two-gun turret; and Brunner points out that a fort with ten such turrets will even be cheaper than a fort for twenty unarmoured guns, on account of its much smaller size. But the uncertainty of artillery progress makes it unsafe to stake much on them, and so they stand on the footing of defensive luxuries, additions to works which are not dependent upon them, but for which no money is grudged. It is said that there are not more than a dozen turrets in the whole of the fortresses of Germany. They are chiefly to be used, according to Wagner, for giving protection from curved fire to heavy guns which are hidden from view, and are themselves to be laid indirectly, as on the keep of the fort referred to above.

In the French forts iron has been more largely used, shields being provided for several guns on the ramparts. Shields give a much more restricted field of fire than turrets, and their ports cannot be averted from the enemy when not in use; but they cost much less, and it is easier to increase their thickness if it should become necessary at any time, supposing that they are made of plates bolted together. It is a great drawback to the chilled cast-iron (Gruson's patent) which is now being so largely adopted abroad, both for shields and turrets, that it will hardly admit of any such subsequent strengthening.

"A great step will have been made," says Brialmont, "when some one has invented a disappearing carriage of simple construction and moderate cost, which will allow of fire over a parapet about 10 feet high." The Moncrieff counterweight carriage does not seem to be accepted abroad as satisfying the essential conditions. Looking upon this as too expensive and too liable to injury, but wishing to obtain its advantages of shelter and all-round fire, Count Geldern, of the Austrian Engineers, proposes to use lifting platforms working spirally in circular pits. He has given a design for a T-shaped fort, to mount six heavy guns in pits upon the head, and six field-guns on the flanks. Comparing it with an ordinary lunette armed with seventeen heavy guns and four field-guns, he shows that in most directions it will be able to bring more guns to bear, while in the cost of construction and in the strength of the garrison needed for it, there will be a saving of nearly 40 per cent. Apart from the question of the mechanism, this design, if not quite satisfactory for an independent work, has much to recommend it for a keep.

In the several types of forts that have been mentioned there is little difference as regards the flank defence of the ditch, with the exception of the one just noticed, in which counterscarp casemates are employed. All the others have

[1] "Sammlung von Constructions—Details der Kriegsbaukunst, lithographirt im k. k. t. und a. Militär-Comité." Wien, 1880.

small one-tier caponiers, placed where they are least exposed to fire along the ditch, sunk sufficiently to be sheltered from shots descending at 15° from the crest of the glacis, and projecting beyond the escarp only so far as will afford space for two guns or half-a-dozen muskets. The space necessary is more narrowly reckoned in some cases than in others, in order to lessen as much as possible the retirement of the counterscarp opposite the caponiers, which—unless the glacis is raised correspondingly—will make it easier for the enemy to breach the escarp there. A gun can be worked in a width of 9 feet, and a mitrailleur in less ; and iron columns can be used, instead of brick walls, to carry the roof ; so that the projection of the caponier may be reduced to about 20 feet. But that gives very little room for the detachments, and hardly admits of loopholes for musketry in addition to the gunports. A width of 13 feet (4 m.) for the gunrooms is more convenient, and has been adopted in the caponiers of the French forts. Iron caponiers have been provided for a few German works where it was not possible to screen masonry from curved fire. Apart from their greater resistance when struck, they can be better covered by the glacis, as their total height from the gun-floor need only be about 10 feet instead of 20 feet. With wide wet ditches like those of the Antwerp forts, iron, at all events in the form of shields, seems indispensable for the caponiers.

Mitrailleurs, if they can be relied upon not to get out of order, are more effective for flanking ditches than either guns or musketry ; and they take up less space than guns, and require fewer men to serve them. The French have adopted for the new Paris forts a pattern of the Hotchkiss 5-barrelled revolving gun, which has a calibre of 1·57 inches, and fires a case-shot containing 24 hardened bullets of $1\frac{1}{4}$ oz. each. "The gun is sighted and fixed once for all in the caponier, so that, in a surprise during day or night, it is only necessary to turn the crank, and the gun will discharge 60 to 80 canister shots per minute, consisting of 1,500 to 2,000 balls."[1] The central caponiers of these forts have three gunrooms on each flank, and as their size exposes them to curved fire, the front walls of the gunrooms are masked by carrying the arches forward about 20 feet beyond them. The casemates in the head of the caponier are also extended laterally, and form orillons sheltering the flanks, so that the plan reminds one of the early Italian bastions.

Brialmont, while adopting "minimum caponiers" in ordinary cases, considers that forts intended to resist a systematic attack to the very last ought to have large caponiers with wide gunrooms protected by masks ; and he would give them overlapping heads with acute salients, like those of the Antwerp forts, so that they can be flanked from the ramparts.

The heads of the French and German caponiers are unflanked, and defended only by their own loopholes, which in the case of the former are machicolated. There are counterscarp galleries opposite to them, but these are solely for countermining, and are not loopholed, according to Brialmont. As they have no underground communication with the fort, but open into the ditch, it is assumed—surely a very questionable assumption—that men would not stay in them, and that loopholes would be useful only to the enemy. No doubt any reverse defence is likely to fail sooner or later in case of a regular siege, but, as has often been remarked, a fortress has done its chief duty when once it has compelled the enemy to besiege it in form. With detached forts especially, it is assault that it is of most importance to be absolutely secure against ; attempts on the caponiers—to blind the loopholes, blow in part of the walls, or smoke out the defenders, would be the accompaniment of any assault, and would largely influence its success ; and it seems very desirable to supplement mere direct defence in some way, for the head as well as for the flanks.

[1] "Royal United Service Institution Journal," vol. xxiv, p. 287.

"A little while ago," says Colonel Muller,[1] "there was a general predilection for those modes of attack which promised to give escape from a regular siege. But this has lessened with discussion, and consequently the formation of rules for the conduct of the systematic attack has been recently taken up with zeal." Strenuous advocates of the more rapid methods are, however, still to be found. The second part of Major Scheibert's work, published in 1881, "Die Befestigungskunst und die Lehre vom Kampfe," is little else than a vigorous argument in favour of storming the new French frontier fortresses on the outbreak of another war.

In some way or other a place must be got possession of if it blocks the main artery upon which the very life of an invading army now depends, and this, he argues, ought to be done within three weeks from the beginning of hostilities. But the regular siege of a great modern fortress will occupy from three to six months—the duration of a war in these days. The fortress is at its weakest when the enemy first comes before it, and the more promptly and vigorously it is attacked the less are the chances of the defence. The garrison—sure, as Von Scherff says, to consist of second-rate troops—half organized and new to their work, will warrant bold measures against it. If the assailants wait to fortify an investment line, and bring up a siege train, each day's delay will improve the state of the garrison, and of their works. With an eye especially to Verdun and Toul (of which he gives sketches), he dwells upon the wide intervals between the French forts, and the impossibility of arming and fortifying these intervals, and of clearing away the masses of wood in their front and rear, in the fortnight which there would be for preparation before the German armies appeared. A certain French fortress (Verdun?) has a garrison of 29,000 infantry. Of these, 9,000 are required for the forts and enceinte, and 6,000 to furnish outposts and guard the intervals on the further side; leaving only 14,000 for the same purpose on the side attacked, or one man to 1·5 mètres. It would be an easy matter, he concludes, for the assailants to break through the intervals at once, especially under cover of night or mist, to establish themselves there firmly, and either push forward directly upon the town, or assault some of the more isolated forts at the gorge while attacking them at the same time in front. The front faces will have about 14 heavy guns and 250 infantry to oppose such an attack. To keep down their fire, 1,250 infantry can be hastily intrenched within 500 mètres, and can be well supported by field artillery. These ought to make it impossible for the gunners of the forts to serve their guns.

Escalade is not so difficult a thing, in his opinion, as people suppose. Caponiers are held in too much awe. It is quite possible to close upon them, and to blind their ports and loopholes; and besides, men when firing through loopholes in masonry are by no means themselves secure from fire, and their defenders, few and isolated, are likely to think more of their own safety than of their duty. But if escalade seems to be impracticable a lodgment must be made upon the glacis, and mining or heavy guns must be employed to get rid of the obstacles in the ditch.

From the point of view of the attack Major Scheibert's arguments, and the experience of recent sieges to which he appeals are very far from convincing; but from the point of view of the defence they are worth bearing in mind.

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[1] "Geschichte des Festungskrieges" (1880).

THE TELELOG.

Translated by Captain J. C. Dalton, R.A.

From the "Militair Wochenblatt" of 15th February, 1882.

Captain Gaumet, a French Officer, the inventor of the Telemeter and Kampylometer, has laid before the Academy of Sciences in Paris a new apparatus for optical telegraphy.

The invention of the light signals of Colonels Mangin and Laussedat facilitates the transmission of messages with certainty for very long distances, but requires costly and intricate apparatus.

Similarly, too, as regards the practicable optical telegraphs that have been in use up to now, by which dark signals were made visible by standing out in relief against the bright sky-line; they were bulky and difficult to transport, their employment and efficiency were influenced by the state of the atmospheric background, and required for their manipulation commanding points far removed from human habitations.

The apparatus of Captain Gaumet avoids all these inconveniences, and can be used where no commanding ground exists, and therefore does not need a sky-line and distant view, and thereby in these particulars surpasses the existing apparata.

It can be put up anywhere, is cheap and easily transported, and any soldier can work it.

It is very simple, and consists of a so-called "Album," of forty pale-black linen tables, about $2\frac{1}{2}$ feet high by 2 feet wide. On each table is a large silvered letter or numeral.

One of these tables is placed on an easel, and inclined towards the horizon; the metal when inclined in a certain direction catches the rays of light and reflects them towards the opposite observer; the silver letter at the same time is lit up, shows up clear and white against the dark ground, and can be read at long distances.

When the eye gets accustomed to the work the distance can be considerably increased. Once the necessary degree of inclination is given and fixed, it is then sufficient to signal the message letter by letter, at the rate of twenty words in four or five minutes; the separation of the words is arranged by a conventional sign, for example a silver rectangle; the same sign repeated furnishes the necessary punctuation.

Each of the tables moreover bears a mark by which it can be readily known.

On the size of the album and on the goodness of the telescope depends the distance that can be signalled. For smaller distances up to $2\frac{1}{2}$ miles the apparatus weighs about $4\frac{1}{2}$ lbs., there are also apparata for 5 up to 7 miles. For longer distances Mangin's apparatus is recommended.

For distances under 5 miles the Telelog is recommended, and most certainly in the cases when the employment of the electric telegraph is difficult—as for example in Africa, where the wires are constantly being disturbed, in the zones between single detached forts, entrenchments, advanced posts, on the battle-field, &c.

NOTICE OF BOOK.

Traité Théorique et Pratique de la Régulation et de la Compensation des Compas avec ou sans Relèvements. By A. Collet, Lieutenant de Vaisseau, Répétiteur de l'École Polytechnique. Paris: Challamel Aîné, Editeur. 1882. Price 8*s*. Pp. 295. Size 10″ × 6·5″ × 0·8″. Weight 1 lb. 8 ozs.

AMONGST the many books published during recent years on the subject of the compass on board ship, that by Lieutenant Collet will probably hold a prominent place. The author's endeavour has been to bring together concisely in one volume much that can be only found by reference to various text-books, taking the English "Admiralty Manual for the Deviations of the Compass" as "basis, guide, and model."

The subject is treated of in five parts, subdivided into chapters, and preceded by a very interesting historical reference to the several theoretical and practical workers in this branch of science, by whose labours the modern navigator so fully profits.

Commencing with a short description of the anomalies experienced by the navigators of the seventeenth and eighteenth centuries in the action of their compasses on board ship, M. Collet shows that the well-known Captain Flinders, in the early part of the present century, was the first to discover the laws which governed the deviations of the compass in ships of his day, and that he invented the means of mechanical correction known now as Flinders' bar, recently adopted by Sir William Thomson for his patent compass. It can hardly fail to be a source of legitimate satisfaction to the English reader when he finds that, with the exception of Poisson, it is to his own countrymen—among whom we may specially mention Airy, Smith, and Evans—that he chiefly owes the perfection to which the system of ascertaining and correcting the deviations of the compass has been brought. His gratification will be the greater that the tale is faithfully told by a French Officer who has evidently read largely and accurately.

The historical part of the treatise is followed by a preliminary chapter in two sections. The first section is devoted to such portions of elementary mechanics as are necessary to a clear understanding of the action of compasses, and the theoretical treatment of their deviations resulting from the ship's iron. The second treats of natural and artificial magnets, induction in soft iron, terrestrial magnetism, charts of equal lines of magnetic variation, dip, and horizontal force, and the instruments used for observing the horizontal and vertical forces on board ship which are necessary for ascertaining her magnetic condition, and for the accurate application of correctors.

Treating next directly of the deviations of the compass, the author in the first three parts follows nearly on the lines of the "English Admiralty Manual" (Part III and Appendices), somewhat curtailing the mathematical portion. His remarks on the choice of a compass and on pivots and caps, in pp. 96, 97, are worthy the attention of the student and the practical man. Par. 5, p. 97, on the length of compass needles, makes it a necessity "to have needles sufficiently short that their length may without sensible error be considered zero with respect to the neighbouring iron bodies and correctors, whether magnets or soft iron." The importance of the teaching of this paragraph will be more evident when it is considered that the fundamental equations of Archibald Smith's mathematical investigations were, by their author Poisson, based on the assumption that the length of the compass needle is infinitely small compared to the distance of the surrounding iron.

Part IV describes very fully the details of the complete correction of the deviations of the compass on board ship, and Lieutenant Collet writes very strongly on its necessity. After mentioning the inconvenience of large errors in single vessels, he says:—"This inconvenience felt on board a ship sailing alone may become

dangerous to vessels sailing in a squadron in close order, and which must alter course simultaneously to change the order of formation." Again—"With the introduction of iron and armour-plated steamships it became a duty to seek after a compass without deviation."

Acting on these convictions, he devotes a chapter to the description of two recently patented compasses, in which a system of correctors is provided for reducing their deviations at a given time and place to less than a degree on any azimuth. These are Sir William Thomson's, and that of Lieutenant Peichl of the Imperial Austrian Navy. The readers of this Journal will have already seen full particulars relating to the first of these compasses, and in the work under review will be found a full description of Lieutenant Peichl's. It will suffice here to indicate the main points of difference between these compasses and their correctors.

In Sir William Thomson's compass the needles are short and of low magnetic force, the consequence being that the constant parts of the deviation once corrected by soft iron, the correction remains perfect in all latitudes, and further, by moving the permanent magnet correctors from time to time, the compass may be kept practically free from error.

In Lieutenant Peichl's compass the ordinary long and powerful needles are retained, and considerable magnetic induction is caused by them in the soft iron correctors, which are placed differently from those in Sir William Thomson's compass. The result of this induction from the compass needles is, that the constant deviation is not quite so accurately corrected even in one latitude, and the soft iron correctors must be moved on change of magnetic latitude similarly to the magnets, if the compass is to be kept nearly correct.

M. Collet, in a paragraph comparing these two compasses, p. 238, concludes thus:—"If one must really make a choice of one or other, the preference should be given to Sir William Thomson's, as much on account of its principles as because it appears to us, both as a whole and in detail, the strongest, as least requiring the help of the maker, and, consequently, best suited to the service on board ship, which above all requires simplicity and strength."

The fifth and last part describes Sir William Thomson's and Lieutenant Peichl's instruments for correcting the compass without bearings of sun or distant object, and in thick weather. The first of these would, in practised hands, be efficient in all latitudes; the latter appears rather to be suited for use in certain magnetic latitudes, and different needles are required in north and in south dip. It may also be remarked that although Lieutenant Peichl shows originality and ingenuity, experience rather points to uncertain results from his instrument—depending as it does upon the steady action of a dipping needle bearing a mirror—in any but very smooth water.

There can be little doubt that this book will prove of great interest to those wishing to obtain the most recent information relative to the compass on board ship and the various means of correcting its errors. It is given there from a theoretical—and in a less degree—from a practical point of view. Beyond this the careful reader will find that the search after a compass which shall *always* be correct is as yet perfectly fruitless.

At page 266, the author makes the following important remarks as a conclusion to his work. After some valedictory remarks on Sir William Thomson's compass and its auxiliary apparatus, he writes:—"But for fear that the success obtained should inspire the seaman with a too decided, and, consequently, dangerous confidence, we would lay before him a final rule, in our opinion the most important of all. This rule—adopted in turn by Archibald Smith, Captain Evans, Sir William Thomson, and in fact by all scientific men who have been engaged on this question, and insisted upon in their writings—derives, as it seems to us, a character of peculiar weight from the name of him who formulated it for the first time, Sir George Airy, Astronomer Royal of England, and one of the highest scientific authorities of this age."

Sir George Airy's rule: "As a general rule, a corrected compass ought to be considered available in the same manner as a chronometer for longitude. Very great reliance may be placed on it for even very long distances, but it ought to be checked at every possible opportunity."—E. W. C.